SOLUTION OF TRIANGLES

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A TREATISE ON THE USE OF FORMULAS AND THE PRACTICAL APPLICATION OF TRIGONOMETRY AND LOGARITHMS IN THE SOLUTION OF SHOP PROBLEMS INVOLVING RIGHT-ANGLED AND OBLIQUE-ANGLED TRIANGLES

BY

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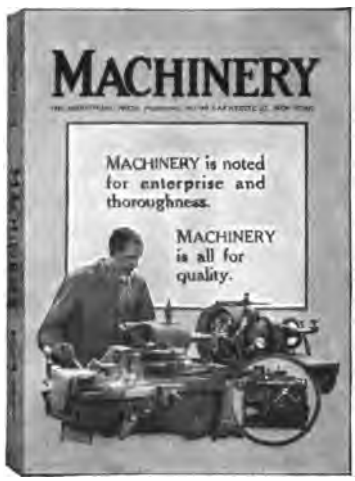

PREFACE

THIS book is intended primarily for men in machine shops, tool-rooms and drafting-rooms, requiring a condensed treatise covering the use of formulas and the solution of triangles. Problems involving right-angled triangles are so numerous and a knowledge of their solution is of such value to the average man in the mechanical field, that a book dealing specifically with the more important problems of the kind mentioned, will doubtless be of direct assistance to a great many whose experience and training has been chiefly along practical lines.

The use of formulas is dealt with in the first chapter in view of the fact that many shopmen do not understand the value of formulas and have erroneous ideas regarding the difficulties of applying them to practical problems. Positive and negative quantities also frequently cause confusion and result in errors, and for this reason the principles covering the use of such quantities have been carefully explained before presenting problems in which positive and negative values occur. In dealing with the solution of various problems involving right-angled and oblique-angled triangles, examples have been selected to cover all cases liable to arise in connection with ordinary work. The presentation of complex trigonometrical problems has been avoided, since the primary object of this treatise is to give the student a good working knowledge of those branches of trigonometry which are the most frequently employed in every-day shop and drafting-room practice.

E. O.

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CHAPTER I

THE USE OF FORMULAS

In mathematical and mechanical books and treatises, as well as in articles containing calculations published in the engineering journals, formulas are used to a great extent instead of rules. In these formulas, signs and symbols are used in order to condense into a small space the essentials of what would otherwise be long and cumbersome rules. The symbols used are generally the letters in the alphabet, and the signs are simply the ordinary signs for arithmetical calculations, with some additional ones necessary for special purposes. Letters from the Greek alphabet are commonly used to designate angles, and the Greek letter π (pi) is always used to indicate the proportion of the circumference of a circle to its diameter; π, therefore, is always, in formulas, equal to 3.1416. The most commonly used Greek letters, besides π, are α (alpha), β (beta), and γ (gamma).

Knowledge of algebra is not necessary in order to make possible the successful use of formulas for the solving of problems such as occur in the solution of triangles; but a thorough understanding of the rules and processes of arithmetic is very essential. The symbols or letters used in the formulas simply stand in place of the actual figures or numerical values which are inserted in the formula in each specific case, according to the requirements of the problem to be solved. When these values are inserted, the result required may be obtained by simple arithmetical processes.

There are two main reasons why a formula is preferable to a rule expressed in words. Firstly, the formula is more concise, it occupies less space, and it is possible for the eye to catch at a glance the whole meaning of the rule laid down; secondly. it is easier to remember a short formula than a long rule, and it is, therefore, of greater value and convenience, as it is not always possible to carry a handbook or reference book about, but the memory must be relied upon to store up a number of the most frequently occurring mathematical and mechanical rules.

The use of formulas can be explained most readily by actual examples. In the following, therefore, a number of simple formulas will be given, and the values will be inserted so as to show, in detail, the principles involved.

Example 1.—When the diameter of a circle is known, the circumference may be found by multiplying the diameter by 3.1416. This rule, expressed as a formula, is:

$$C = D \times 3.1416$$

in which C = circumference of circle,
D = diameter of circle.

This formula shows at a glance, that no matter what the diameter of the circle be, the circumference is always equal to the diameter times 3.1416. Let it be required to find, for example, the circumference of a circle 22 inches in diameter. If then we insert 22 in the place of D in the formula, we have:

$$C = 22 \times 3.1416 = 69.1152 \text{ inches.}$$

Hence, our formula gives, by means of a simple multiplication, the result required.

Assume that the diameter of a circle is 3.72 inches. The circumference of this circle is found by inserting this value instead of D in the formula:

$$C = 3.72 \times 3.1416 = 11.6867 \text{ inches.}$$

Example 2.—In spur gears, the outside diameter of the gear can be found by adding 2 to the number of teeth, and dividing the sum obtained by the diametral pitch of the gear. This rule can be expressed very simply by a formula. Assume that we write D for the outside diameter of the gear, N for the number of teeth, and P for the pitch. Then the formula would be

$$D = \frac{N + 2}{P}$$

This formula reads exactly as the rule given above. It says that the outside diameter (D) of the gear equals 2 added to the number of teeth (N), and this sum divided by the pitch (P).

If the number of teeth in a gear is 16 and the pitch 6, then simply put these figures in the place of N and P in the formula, and find the outside diameter as in ordinary arithmetic.

$$D = \frac{16 + 2}{6} = \frac{18}{6} = 3.$$

D, or the outside diameter, then, is 3 inches.

In another gear the number of teeth is 96 and the pitch 7; find the outside diameter of the gear.

$$D = \frac{96 + 2}{7} = \frac{98}{7} = 14 \text{ inches.}$$

From the examples given it will be seen that in formulas, each letter stands for a certain dimension or quantity. When using a formula for solving a problem, replace the letters in the formula by the figures given in a certain problem, and find the result as in a regular arithmetical calculation.

Example 3.—The formula for the horse-power of a steam engine is as follows:

$$\text{H. P.} = \frac{P \times L \times A \times N}{33{,}000}$$

in which H. P. = indicated horse-power of engine,

P = mean effective pressure on piston in pounds per square inch,

L = length of piston stroke in feet,
A = area of piston in square inches,
N = number of strokes of piston per minute.

Assume that $P = 90$, $L = 2$, $A = 320$, and $N = 110$; what would be the horse-power?

If we insert the given values in the formula we have:

$$\text{H. P.} = \frac{90 \times 2 \times 320 \times 110}{33{,}000} = 192$$

In formulas, the sign for multiplication ($\times$) is often left out between letters the values of which are to be multiplied. Thus AB means $A \times B$, and the formula

$$\frac{P \times L \times A \times N}{33{,}000} \text{ can also be written } \frac{PLAN}{33{,}000}$$

Thus; if $A = 3$, and $B = 5$, then:

$$AB = A \times B = 3 \times 5 = 15$$

If $A = 12$, $B = 2$, and $C = 3$, then:

$$ABC = A \times B \times C = 12 \times 2 \times 3 = 72$$

It is only the multiplication sign ($\times$) that can be thus left out between the symbols or letters in a formula. All other signs must be indicated the same as in arithmetic.

A parenthesis ( ) or bracket [ ] in a formula means that the expression inside the parenthesis or bracket should be considered as one single symbol, or in other words, that the calculation inside the parenthesis or bracket should be carried out by itself, before other calculations are carried out.

Examples:

$6 \times (8 + 3) = 6 \times 11 = 66$

$5 \times (16 - 14) + 3\ (2.25 - 1.75) = 5 \times 2 + 3 \times 0.5 = 10 + 1.5 = 11.5$

In the last example above it will be seen that 5 is multiplied by 2 and 3 by 0.5, and then the products of these two multiplications are added. From the order of the numbers $5 \times 2 + 3 \times 0.5$, one might have assumed that the calculation should have been carried out as follows: 5 times 2 = 10, plus 3 = 13, times 0.5 = 6.5. This latter procedure, however, is not correct.

When several numbers or expressions are connected by the signs $+$, $-$, $\times$ and $\div$, the operations are carried out in the order written, except that *all multiplications should be carried out before the other operations.* The reason for this is that numbers connected by a multiplication sign are only factors of the product thus indicated, which product should be considered by itself as one number. Divisions should be carried out before additions and subtractions, if the division is indicated in the same line with these other processes.

Examples:

$5 \times 6 + 4 - 6 \times 4 = 30 + 4 - 24 = 34 - 24 = 10$

$5 + 3 \times 2 = 5 + 6 = 11$

$100 \div 2 \times 5 = 100 \div 10 = 10$

$3.5 + 16.5 \div 3 - 1.75 = 3.5 + 5.5 - 1.75 = 7.25$

But $5 \times (6 + 4) - 6 \times 4 = 5 \times 10 - 24 = 50 - 24 = 26$

$(5 + 3) \times 2 = 8 \times 2 = 16$

$(100 \div 2) \times 5 = 50 \times 5 = 250$

$(3.5 + 16.5) \div (3 - 1.75) = 20 \div 1.25 = 16$

Formulas Containing Square and Cube Roots

The square of a number is the product of that number multiplied by itself. The square of 2 is $2 \times 2 = 4$, and the square of 10 is $10 \times 10 = 100$; similarly the square of 177 is $177 \times 177 = 31{,}329$. Instead of writing 4×4 for the quare of 4, it is often written 4^2 which is read *four square*, and means that 4 is multiplied by 4. In the same way 128^2 means 128×128. The small figure (^{2}) in these expressions is called *exponent*.

The square root of a number is that number which, when multiplied by itself, will give a product equal to the given number. Thus, the square root of 4 is 2, because 2 multiplied by itself gives 4. The square root of 25 is 5; of 36, 6, etc. We may say that the square root is the reverse of the square, so that if the square of 24 is 576, then the square root of 576 is 24. The mathematical sign for the square root is $\sqrt[2]{\ }$, but the *index figure* (^{2}) is generally left out, making the square-root sign simply $\sqrt{\ }$, thus:

$\sqrt{4} = 2$ (the square root of four equals two),

$\sqrt{100} = 10$ (the square root of one hundred equals ten).

The operation of finding the square root of a given number is called *extracting* the square root. Squares and square roots as well as cubes and cube roots of all numbers up to 1,000 (sometimes up to 1,600) are generally given in all standard handbooks.

The cube of a number is the product obtained if the number itself is repeated as a factor three times. The cube of 2 is $2 \times 2 \times 2 = 8$, and the cube of 12 is $12 \times 12 \times 12 = 1{,}728$. Instead of writing $2 \times 2 \times 2$ for the cube of 2, it is often written 2^3, which is read "two cube." In the same way 128^3 means $128 \times 128 \times 128$. The small figure (^{3}) in these expressions is called *exponent*, the same as in the case of the figure (^{2}) indicating the square of a number. An expression of the form 18^3 may also be read the "third power of 18."

In the same way as square root means the reverse of square, so cube root means the reverse of cube; that is, the cube root of a given number is the number which, if repeated as factor three times, would give the number given. Thus the cube root of 27 is 3, because $3 \times 3 \times 3 = 27$. If the cube of 15 is 3,375, then the cube root of 3,375 is, of course, 15. The mathematical sign for the cube root is $\sqrt[3]{\ }$, thus:

$\sqrt[3]{64} = 4$ (the cube root of sixty-four equals four),

$\sqrt[3]{4096} = 16$ (the cube root of four thousand ninety-six equals sixteen)

Assume, for an example, that a formula is given as follows:

$$A = \frac{\sqrt{B} \times C}{D}$$

Let $B = 36$, $C = 3.5$, and $D = 10.5$. Find the value of A.

If we insert these values in the formula, we have:

$$A = \frac{\sqrt{36} \times 3.5}{10.5} = \frac{6 \times 3.5}{10.5} = \frac{21}{10.5} = 2$$

As another example, find the value of A in the formula

$$A = \frac{B^2 + C^2}{D^2}, \text{ if } B = 5,\ C = 7, \text{ and } D = 2$$

If we insert these values in the formula, and carry out the calculation, remembering that $5^2 = 5 \times 5$, $7^2 = 7 \times 7$, etc., we have:

$$A = \frac{5^2 + 7^2}{2^2} = \frac{25 + 49}{4} = \frac{74}{4} = 18.5$$

Find the value of A in the formula

$$A = \sqrt{B^2 + C^2}, \text{ if } B = 8 \text{ and } C = 6$$

If we insert the given values in the formula, we have:

$$A = \sqrt{8^2 + 6^2} = \sqrt{8 \times 8 + 6 \times 6} = \sqrt{64 + 36} = \sqrt{100} = 10.$$

The examples given indicate the principles involved in the use of formulas, and show, as well, how easily formulas may be employed by anyone who has a general understanding of arithmetic.

CHAPTER II

ANGLES AND ANGULAR MEASUREMENTS

When two lines meet as shown in Fig. 1, they form an angle with each other. The point where the two lines meet or intersect is called the *vertex* of the angle. The two lines forming the angle are called the sides of the angle.

Angles are measured in degrees and subdivisions of a degree. If the circumference (periphery) of a circle is divided into 360 parts, each part is called one degree, and the angle between two lines from the center to the ends of this small part of the circle is a one-degree angle, as shown in Fig. 2. As the whole circle contains 360 degrees, one-half of a circle contains 180 degrees, and one-quarter of a circle, 90 degrees, as shown in Fig. 9.

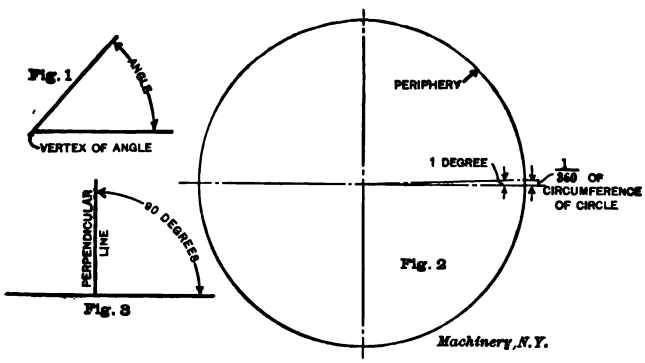
A 90-degree angle is called a *right* angle. An angle larger than 90 degrees is called an *obtuse* angle, and an angle less than 90 degrees is called an *acute* angle. (See Fig. 10.) Any angle which is not a right angle is called an *oblique* angle.

When two lines form a right or 90-degree angle with each other, as shown in Fig. 3, one line is said to be *perpendicular* to the other.

Angles are said to be equal when they contain the same number of degrees. The angle in Fig. 4 and the angle in Fig. 5 are equal, because they are both 60 degrees; that the sides of the angle in Fig. 5 are longer than the sides of the angle in Fig. 4 has no influence on the angle because of the fact that an angle is only the *difference in direction* of two lines. The angle in Fig. 6 which contains only 30 degrees is only one-half of the angle in Fig. 4.

One-half of a right angle is 45 degrees, as shown in Fig. 7. In Fig. 8 is shown an angle which is 120 degrees, and which can be divided into a right or 90-degree angle, and a 30-degree angle.

In order to obtain finer subdivisions for the measurement of angles than the degree, one degree is divided into 60 minutes, and one minute into 60 seconds.



Figs. 1 to 3

Any part of a degree can be expressed in minutes and seconds, for instance, 1/2 of a degree = 30 minutes, 1/3 of a degree = 20 minutes; and since 1/4 of a degree = 15 minutes, 3/4 of a degree = 45 minutes. In the same way 1/2 minute = 30 seconds, 1/4 minute = 15 seconds, and 3/4 minute = 45 seconds.

The word degree is often abbreviated "deg." or the sign (°) is used to indicate degrees; thus, 60° = 60 degrees. In the same way 60′ = 60 min. = 60 minutes, and 60″ = 60 sec. = 60 seconds; and 60° 50′ = 60 degrees 50 minutes.

When adding and subtracting degrees and minutes, care must be exercised not to make mistakes on account of there being but 60 minutes in a degree, instead of the usual 100 units met with when adding, for example, dollars and cents.

Example 1.—Add the two angles 60 deg. 32 min. and 35 deg. 16 min.

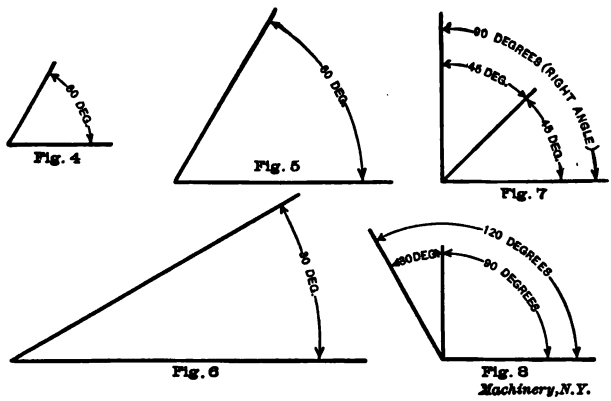
60 deg. 32 min.
35 deg. 16 min.

95 deg. 48 min.

Example 2.—Add 15 deg. 43 min. to 12 deg. 27 min.

15 deg. 43 min.
12 deg. 27 min.

28 deg. 10 min.



Figs. 4 to 8

In this example the total sum of 43 and 27 minutes is 70 minutes; as 70 minutes, however, contains one whole degree (60 minutes), this is carried over and added to the degrees, leaving 10 minutes in the minute column, and 15 + 12 + 1 = 28 degrees in the degree column.

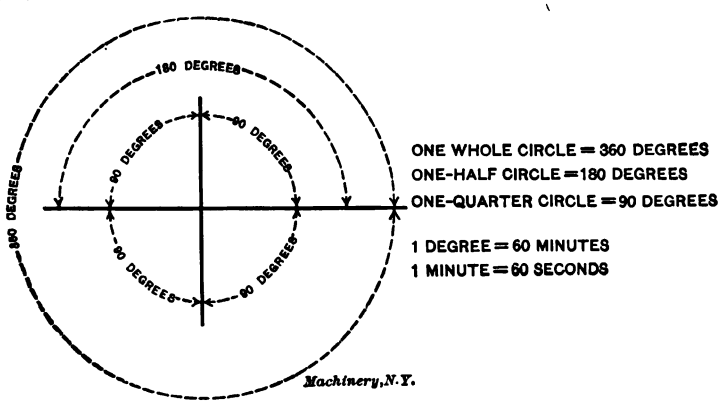


Fig. 9

Example 3.—Add 59 deg. 12 min., 16 deg. 53 min., and 103 deg. 55 min.

59 deg. 12 min.
16 deg. 53 min.
103 deg. 55 min.

180 deg. 0 min.

In adding the minutes (12 + 53 + 55 = 120 min.) we find that their sum equals 2 whole degrees. These are then carried over to the degree column and the total sum equals 59 + 16 + 103 + 2 = 180 deg.

Example 4.—Subtract 12 deg. 17 min. from 21 deg. 39 min.

21 deg. 39 min.
12 deg. 17 min.

9 deg. 22 min.

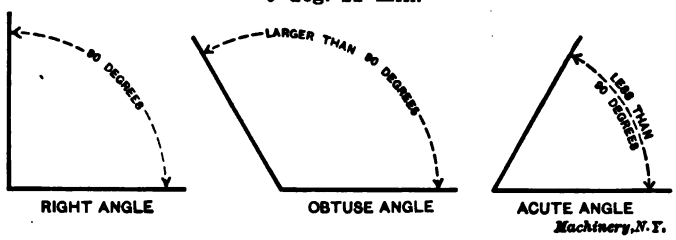


Fig. 10

Example 5.—Subtract 31 deg. 43 min. from 106 deg. 12 min.

106 deg. 12 min.
31 deg. 43 min.

74 deg. 29 min.

In this case we must borrow from the degrees. One deg. = 60 min. and 60 + 12 = 72; then 72 — 43 = 29 min. Having borrowed one degree from 106, we have 105 — 31 = 74 deg.

CHAPTER III

POSITIVE AND NEGATIVE QUANTITIES

In order to be able to use correctly the formulas for the solution of triangles under certain conditions, a working knowledge of the principles of positive and negative numbers or quantities is required. In this chapter, therefore, an explanation of the meaning of these expressions will be given, together with the rules for calculations with negative numbers, and examples to make the rules thoroughly understood.

On the thermometer scale, as is well known, the graduations extend upward from zero, the degrees being numbered 1, 2, 3, etc. Graduations also extend downward and are numbered in the same way: 1, 2, 3, etc. The degrees on the scale extending upward from the zero point may be called *positive* and preceded by a plus sign, so that, for instance, + 5 degrees means 5 degrees above zero. The degrees below zero may be called *negative* and may be preceded by a minus sign, so that — 5 degrees means 5 degrees below zero.

The ordinary numbers may also be considered positive and negative in the same way as the graduations on a thermometer scale. When we count 1, 2, 3, etc., we refer to the numbers that are larger than 0 (corresponding to the degrees *above* the zero point), and these numbers are called positive numbers. We can conceive, however, of numbers extending in the other direction of 0; numbers that are, in fact, less than 0 (corresponding to the degrees below the zero point on the thermometer scale). As these numbers must be expressed by the same figures as the positive numbers, they are designated by a minus sign placed before them. For example, — 3 means a number that is as much less than, or beyond 0 in the negative direction as 3 (or, as it might be written, + 3) is larger than 0 in the positive direction.

A negative value should always be enclosed within a parenthesis whenever it is written in line with other numbers; for example:

$$17 + (-13) - 3 \times (-0.76)$$

In this example — 13 and — 0.76 are negative numbers, and by enclosing the whole number, minus sign and all, in a parenthesis, it is shown that the minus sign is part of the number itself, indicating its negative value.

It must be understood that when we say 7 — 4, then 4 is not a negative number, although it is preceded by a minus sign. In this case the minus sign is simply the sign of subtraction, indicating that 4 is to be subtracted from 7. But 4 is still a positive number or a number that is larger than 0.

It now being clearly understood that positive numbers are all ordinary numbers greater than 0, while negative numbers are conceived of as less than 0, and preceded by a minus sign which is a part of the number itself, we can give the following rules for calculations with negative numbers.

A negative number can be added to a positive number by subtracting its numerical value from the positive number.

Examples:

$$4 + (-3) = 4 - 3 = 1$$
$$16 + (-7) + (-6) = 16 - 7 - 6 = 3$$
$$327 + (-0.5) - 212 = 327 - 0.5 - 212 = 114.5$$

In the last example 212 is not a negative number, because there is no parenthesis indicating that the minus sign is a part of the number itself. The minus sign, then, indicates only that 212 is to be subtracted in the ordinary manner.

As an example illustrating the rule for adding negative numbers to positive ones, the case of a man having $12 in his pocket, but owing $9, may be taken. His debt is a negative quantity, we may say, and equals (— 9). Now if he adds his cash and his debts, to find out how much he really has, we have:

$$12 + (-9) = 12 - 9 = 3.$$

Of course, in a simple case like this, it is obvious that 9 would be subtracted directly from 12, but the example serves the purpose of illus-

trating the method used when a negative number is added to a positive number.

A negative number can be subtracted from a positive number by adding its numerical value to the positive number.

Examples:

$4 - (-3) = 4 + 3 = 7.$

$16 - (-7) = 16 + 7 = 23.$

$327 - (-0.5) - 212 = 327 + 0.5 - 212 = 115.5.$

In the last example, note that 212 is subtracted, because the minus sign in front of it does not indicate that 212 is a negative number.

As an illustration of the method used when subtracting a negative number from a positive one, assume that we are required to find how many degrees difference there is between 37 degrees above zero and 24 degrees below; this latter may be written (— 24). The difference between the two numbers of degrees mentioned is then:

$37 - (-24) = 37 + 24 = 61.$

A little thought makes it obvious that this result is right, and the example shows that the rule given is based on correct reasoning.

When a positive number is multiplied or divided by a negative number, multiply or divide the numerical values as usual; but the product or quotient, respectively, becomes negative. The same rule holds true if a negative number is divided by a positive number.

Examples:

$4 \times (-3) = -12.$ $\qquad$ $(-3) \times 4 = -12.$

$\frac{15}{-3} = -5.$ $\qquad$ $\frac{-15}{3} = -5.$

When two negative numbers are multiplied by each other, the product is positive. When a negative number is divided by another negative number the quotient is positive.

Examples:

$(-4) \times (-3) = 12.$ $\qquad$ $\frac{-4}{-3} = 1.333.$

If, in a subtraction, the number to be subtracted is larger than the number from which it is to be subtracted, the calculation can be carried out by subtracting the smaller number from the larger, and indicating that the remainder is negative.

Examples:

$3 - 5 = -(5 - 3) = -2.$

In this example 5 cannot, of course, be subtracted from 3, but the numbers are reversed, 3 being subtracted from 5, and the remainder indicated as being negative by placing a minus sign before it.

$227 - 375 = -(375 - 227) = -148.$

The examples given, if carefully studied, will enable the student to carry out calculations with negative numbers when such will be required in solving triangles.

CHAPTER IV

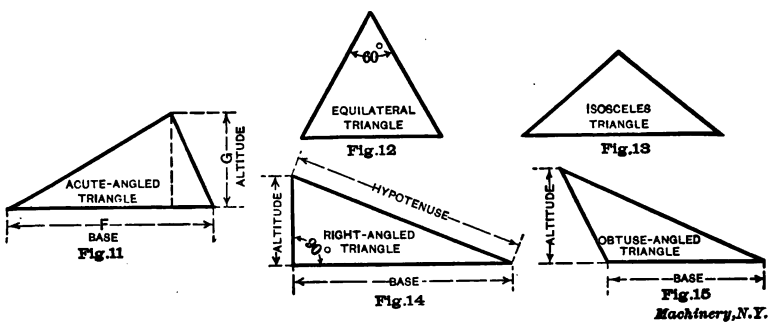
FUNCTIONS OF ANGLES

Any figure bounded by three straight lines is called a triangle. Any one of the three lines may be called the base, and the line drawn from the angle opposite the base at right angles to it is called the height or altitude of the triangle. In Fig. 11, if the side *F* is taken as the base of the triangle, then *G* is the altitude.

If all the three sides of a triangle are of equal length, as in the one shown in Fig. 12, the triangle is called *equilateral.* Each of the three angles in an equilateral triangle equals 60 degrees.

If two sides are of equal length, as shown in Fig. 13, the triangle is an *isosceles* triangle.

If one angle is a right or 90-degree angle, the triangle is called a *right* or *right-angled* triangle. Such a triangle is shown in Fig. 14; the side opposite the right angle is called the *hypotenuse.*



Figs. 11 to 15

If all the angles are less than 90 degrees, the triangle is called an *acute* or *acute-angled* triangle, as shown in Fig. 11. If one of the angles is larger than 90 degrees, as shown in Fig. 15, the triangle is called an *obtuse* or *obtuse-angled* triangle. The sum of the three angles in every triangle is 180 degrees.

Object of Trigonometry and Trigonometric Functions

The object of that part of mathematics called trigonometry is to furnish the methods by which the unknown sides and angles in a triangle may be determined when certain of the sides and angles are given.

The sides and angles of any triangle, which are not known, can be found when:

1. All the three sides, .
2. Two sides and one angle, or
3. One side and two angles,

are given. In other words, if the triangle is considered as consisting of six parts, three angles and three sides, the unknown parts can be determined when any three of the parts are given, provided at least one of the given parts is a side.

In order to introduce the values of the angles in calculations of triangles, use is made of certain expressions called *trigonometrical functions* or *functions of angles*. The names of these expressions are: *sine, cosine, tangent, cotangent, secant, and cosecant.* These exprcssions are usually abbreviated as follows:

sin = sine,	cot = cotangent,
cos = cosine,	sec = secant,
tan = tangent,	cosec = cosecant.

In Fig. 16 is shown a right-angled triangle. The lengths of the three sides are represented by a, b and c, respectively, and the angles opposite each of these sides are called A, B and C, respectively. Angle

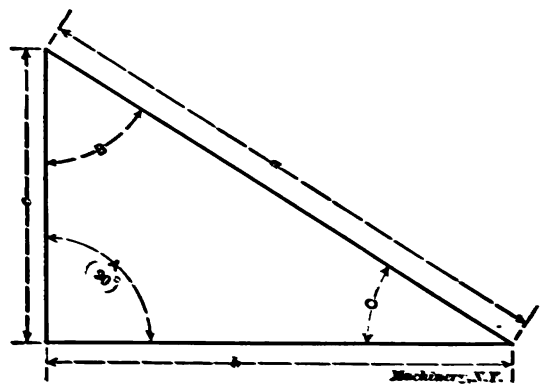


Fig. 16

A is the right angle in the triangle. The side a opposite the right angle is the *hypotenuse*. The side b is called the side *adjacent* to the angle C, but is of course also the side *opposite* to angle B. In the same way, the side c is called the side adjacent to angle B, and the side opposite to angle C. The reason for these names is made clear by studying the figure.

The meanings of the various functions of angles previously named can be explained by the aid of a right-angled triangle.

The sine of an angle equals the opposite side divided by the hypotenuse.

The sine of angle B thus equals the side b, which is opposite to the angle, divided by the hypotenuse a. Expressed as a formula we have:

$$\sin B = \frac{b}{a}.$$

If $a = 16$, and $b = 9$, then $\sin B = \frac{9}{16} = 0.5625$.

The cosine of an angle equals the adjacent side divided by the hypotenuse.

The cosine of angle B thus equals the side c, which is adjacent to this angle, divided by the hypotenuse a, or, expressed as a formula,

$$\cos B = \frac{c}{a}.$$

If $a = 24$, and $c = 15$, then $\cos B = \frac{15}{24} = 0.625$.

The tangent of an angle equals the opposite side divided by the adjacent side.

The tangent of angle B thus equals the side b divided by side c, or,

$$\tan B = \frac{b}{c}.$$

If $b = 28$, and $c = 25$, then $\tan B = \frac{28}{25} = 1.12$.

The cotangent of an angle equals the adjacent side divided by the opposite side.

The cotangent of angle B thus equals the side c divided by the side b, or, $\cot B = \frac{c}{b}$.

If $b = 28$, and $c = 25$, then $\cot B = \frac{25}{28} = 0.89286$.

The secant of an angle equals the hypotenuse divided by the adjacent side.

The secant of angle B thus equals the hypotenuse a divided by the side c adjacent to the angle, or $\sec B = \frac{a}{c}$.

If $a = 24$, and $c = 15$, then $\sec B = \frac{24}{15} = 1.6$.

The cosecant of an angle equals the hypotenuse divided by the opposite side.

The cosecant of angle B thus equals the hypotenuse a divided by the side b opposite the angle, or $\operatorname{cosec} B = \frac{a}{b}$.

If $a = 16$, and $b = 9$, then $\operatorname{cosec} B = \frac{16}{9} = 1.77778$.

The rules given above are very easily memorized, and the student should go no further before he can see at a glance the various functions in a given right-angled triangle.

If the functions of the angle C were to be found instead of the functions of angle B, as given above, they would be as follows:

$$\sin C = \frac{c}{a} \qquad \cos C = \frac{b}{a} \qquad \tan C = \frac{c}{b}$$

$$\cot C = \frac{b}{c} \qquad \sec C = \frac{a}{b} \qquad \operatorname{cosec} C = \frac{a}{c}$$

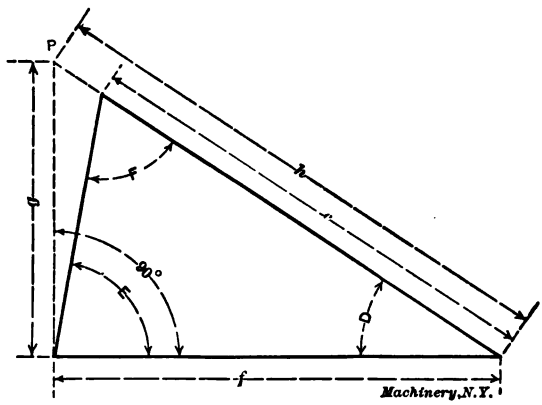


Fig. 17

It must be remembered that the functions of the angles can be found in this manner only when the triangle is right-angled. If the triangle has the shape shown by the full lines in Fig. 17, the sine of angle *D*, for instance, cannot be expressed by any relation between two sides of

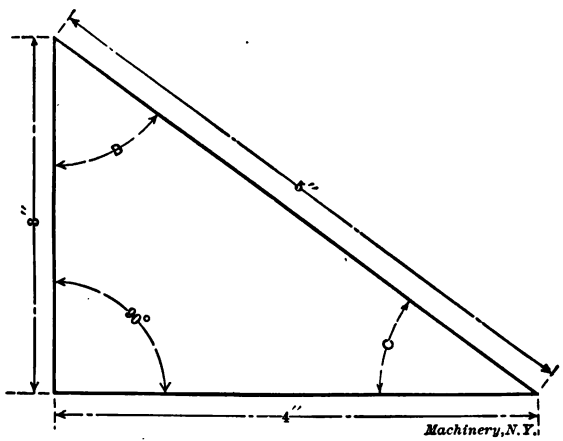


Fig. 18

this triangle. The sine of angle *D*, however, can be found by constructing a right-angled triangle by extending the side *e* to the point *P*, from where a line can be drawn at right angles to the vertex or point of angle *E*, as shown by the dotted line. The sine of angle *D* would then be the length of the dotted line *g* divided by the length of the line *h*,

these two lines being, respectively, the side opposite angle D, and the hypotenuse, in a right-angled triangle. In the same way, the tangent of angle D would be the side g divided by the side f.

Examples for Finding the Values of the Functions of Angles

In Fig. 18 is shown a right-angled triangle where the side opposite angle B is four inches, the side opposite angle C is 3 inches, and the hypotenuse is 5 inches. Find the values of the functions of the angles B and C.

Following the rules previously given for finding the sine, cosine, tangent, etc., we have:

$$\sin B = \frac{4}{5} = 0.8 \qquad \cos B = \frac{3}{5} = 0.6$$

$$\tan B = \frac{4}{3} = 1.333 \qquad \cot B = \frac{3}{4} = 0.75$$

$$\sec B = \frac{5}{3} = 1.667 \qquad \operatorname{cosec} B = \frac{5}{4} = 1.25$$

The functions for angle C are as follows:

$$\sin C = \frac{3}{5} = 0.6 \qquad \cos C = \frac{4}{5} = 0.8$$

$$\tan C = \frac{3}{4} = 0.75 \qquad \cot C = \frac{4}{3} = 1.333$$

$$\sec C = \frac{5}{4} = 1.25 \qquad \operatorname{cosec} C = \frac{5}{3} = 1.667$$

The secant and cosecant, being merely the values of 1 divided by the cosine and sine, are not often used in calculations, or included in tables of angular functions.

By studying the results obtained in the calculations above it will be noted that in a right-angled triangle there is a definite relation between the functions of the two acute angles. The sine of angle B equals the cosine of angle C; the tangent of angle B equals the cotangent of angle C, etc. This is true of all right-angled triangles.

As the sum of the three angles in a triangle always equals 180 degrees, and as a right angle equals 90 degrees, it follows that the sum of the two acute angles in a right-angled triangle equals $180 - 90 = 90$ degrees. The angle B (Fig. 18) which together with angle C forms a 90-degree angle, is called the *complement* of angle C. In the same way angle C is the complement of angle B. When any two angles together make 90 degrees, the one is the complement of the other, and in all such cases, the sine of the one equals the cosine of the other, and *vice versa*, the tangent of the one equals the cotangent of the other, etc.

CHAPTER V

TABLES OF TRIGONOMETRIC FUNCTIONS

When using formulas of the type

$$A = \frac{16 \times \sin 36 \text{ deg.}}{2}$$

it is, of course, not possible to find the value of A unless we have some means of transforming the expression "sin 36 deg." (read: sine of 36 degrees) into plain figures. In other words, we must know the *numerical value* of "sin 36 deg.," before we can calculate A. Assume that "sin 36 deg." equals 0.58779. Then, if we insert this value in the formula, we have:

$$A = \frac{16 \times 0.58779}{2} = 4.70232$$

The numerical values for the natural or trigonometric functions which must thus be found before a formula containing an expression with a trigonometric function can be calculated, can be obtained by referring to the tables in the latter part of this treatise. In the following, when reference to "the tables" is made, these tables are always referred to. From these tables, when the angle is given in degrees and minutes, the corresponding numerical value of any of the trigonometric functions can be found; and if the numerical value of the function is known, the corresponding angle can be determined.

It will be seen in the tables that the number of degrees from 0 degree (0°) to 44 degrees (44°) are given above the tables, and the number of minutes in the left-hand column headed with the minute sign (′), reading downward from 0 to 60. The number of degrees from 45 degrees (45°) to 89 degrees (89°), inclusive, are given at the bottom of the tables, and the minutes for the latter degrees are given in the extreme right-hand column, reading from below and up, from 0 to 60. The four main columns in the tables are headed "Sin," "Cos," "Tan," and "Cot," at the top of the tables, and at the bottom of the same tables are the main legends "Cos," "Sin," "Cot," and "Tan." This indicates that when the sine of an angle is required the number of degrees of which angle is given at the top of the table, the sine will be found in the column headed "Sin" at the top; but when the sine of an angle, the number of degrees of which is given at the bottom, is to be found, the sine is found in the second main column, having the word "Sin" at the bottom. The same, of course, applies to the other functions, cosine, tangent, and cotangent.

By referring to the tables it will be seen further that there are two columns of figures in each of the main columns, one headed "Nat."

(natural function) and one "Log." (logarithm). For the present, we are concerned *with the figures given in the column under "Nat." only*, and will treat the subject as if the logarithms of the functions and the columns headed "d." and "c. d." did not exist. Later, we will return to the use of these.

Assume now that the sine, cosine, tangent or cotangent of an angle between 0 and 45 degrees is to be found. First find the given number of degrees at the top of the table; then find the given number of minutes in the extreme left-hand column. Then, read off the figures in the column of the natural sine, cosine, tangent or cotangent, as the case may be, which is opposite the given number of minutes. This value, just read off, is now the numerical value of the function which was to be found.

In reading off these values, care must be taken to place the decimal point properly, as this point is not always given in the tables. The sine and cosine of angles are never over 1, so that when the table gives the figures 99949 as the cosine of 1 degree 50 minutes, the decimal point should be placed in front of these figures, the value being 0.99949. The same refers to the other functions when no decimal point is given. A decimal point should then always be placed in front of the figures given in the tables.

When the sine, cosine, tangent or cotangent of an angle between 45 and 90 degrees is to be found, first find the given number of degrees at the bottom of the table; then find the number of minutes in the extreme right-hand column. Then read off the required function opposite the number of minutes, in the column marked with the required function at the bottom.

Examples of the Use of Trigonometric Tables

Example 1.—Find from the tables the sine of 56 degrees, or, as it is commonly written, sin 56°.

Find first "56°" at the bottom of its page, and then (as in this case there are no minutes) locate 0′ (0 minutes) in the extreme right-hand column, reading from the bottom up. Then, in the column "Nat. Sin." marked at the bottom, read off 0.82904 opposite 0 minutes, which is the required value of the sine of 56 degrees. (Note that the two first figures (82) in the number 82904 are not given opposite every number but only at every fifth number of minutes, but these two figures are to be prefixed, as is easily understod from the table.)

Example 2.—Find sin 50° 20′.

Find first "50°" at the bottom of its page, and then locate 20′ in the right-hand column, reading from the bottom up. Then, in the column "Nat. Sin." marked at the bottom, read off 0.76977 opposite 20 minutes. This is the required value of sin 50° 20′.

Example 3.—Find tan 36° 26′.

Locate 36° at the top of its table, and 26′ in the left-hand column. Then read off 0.73816 in the column "Nat. Tan." This is the required value of tan 36° 26′.

Example 4.—Find cos 36° 19′.

In the same manner as in the examples above, cos 36° 19′ is found to equal 0.80576.

The student should find the following functions from the tables and then compare the result found with the values given, to check the accuracy of the work:

sin 12° 10′ = 0.21076	cos 60° 0′ = 0.50000
sin 15° 50′ = 0.27284	sin 65° 10′ = 0.90753
tan 1° 20′ = 0.02328	sin 12° 3′ = 0.20877

Trigonometric Functions for Angles greater than 90 Degrees

The tables in the latter part of this book give the angular functions only for angles up to 90 degrees (or 89 degrees 60 minutes, which, of course, equals 90 degrees). In obtuse triangles one angle, however, is greater than 90 degrees, and the tables can be used for finding the functions for angles larger than 90 degrees also.

The sine of an angle greater than 90 degrees but less than 180 degrees equals the sine of an angle which is the difference between 180 degrees and the given angle.

Example: Sin 118° = sin (180° — 118°) = sin 62°. In the same way sin 150° 40′ = sin (180° — 150° 40′) = sin 29° 20′.

The cosine, tangent and cotangent for an angle greater than 90 but less than 180 degrees equals, respectively, the cosine, tangent and cotangent of the difference between 180 degrees and the given angle, but in this case the angular function found has a *negative* value (is preceded by a minus sign).

Example 1.—Find tan 150°.

Tan 150° = — tan (180° — 150°) = — tan 30°. From the tables we have tan 30° = 0.57735; thus tan 150° = — 0.57735.

Example 2.—Find sin 155° 50′.

As explained above sin 155° 50′ = sin (180° — 155° 50′) = sin 24° 10′ = 0.40939.

Example 3.—Find tan 123° 20′.

As explained above tan 123° 20′ = — tan (180° — 123° 20′) = — tan 56° 40′ = — 1.5204.

[In calculations of triangles it is very important that the minus sign is not omitted in the cosines, tangents and cotangents of angles between 90 and 180 degrees.]

Finding the Angle when the Function is Given

When the value of the function of an angle is given, and the angle required in degrees and minutes, the function is located in the tables and the corresponding angle found by a process the reverse of that employed for finding the functions when the angle is given. If the value of the function cannot be found exactly in the tables, use the nearest value found.

Example 1.—The sine of a certain angle, which may be called a, equals 0.53238. Find the angle.

The function 0.53238 is located in the columns marked "Sin" either at the top or at the bottom. When located, the degrees and minutes of

the angle are read off directly. If the function is located in the column marked "Sin" at the top, the number of degrees is read off at the top and the number of minutes in the left-hand column; if the function is located in the column marked "Sin." at the bottom, the degrees are read off at the bottom and the minutes in the right-hand column. Following these rules, we find the required angle to be 32° 10′.

Example 2.—The cotangent of an angle is 0.77196. Find the angle.

By observing the rules given in the previous example we find that the required angle is 52° 20′.

Example 3.—The tangent of angle $a = -3.3402$. Find a.

The positive value 3.3402 is first located and the corresponding angle found. This angle is 73° 20′. As the tangent is negative (preceded by a minus sign) the angle a, however, is not 73° 20′ but (180° — 73° 20′) = 106° 40′.

Example 4.—If $\sin a = 0.29381$, what is the value of angle a?

It will be seen that the function 0.29381 cannot be found exactly in the tables. The nearest value to be found in the sine columns is 0.29376. For practical purposes in machine construction and shop calculations it is near enough to find the angle corresponding to this nearest value. Hence, $a = 17° 5'$.

CHAPTER VI

PRACTICAL APPLICATIONS OF TRIGONOMETRIC FORMULAS

In the following are given a few problems solved by the use of formulas of which trigonometric functions are a part. These examples will show the use of these functions, as obtained from the tables, in cases where it is only required to insert their value in the given formulas.

Example 1.—The depth of the thread in the United States standard screw thread system is expressed by the formula:

$$d = 3/4 \times p \times \cos 30°$$

in which d = depth of thread,

$$p = \text{pitch of thread} = \frac{1}{\text{No. of threads per inch}}$$

Assume that it is required to find the depth of thread for 14 threads per inch. Then $p = \frac{1}{14}$, and

$$d = \frac{3}{4} \times \frac{1}{14} \times \cos 30° = \frac{3}{56} \times 0.86603 = 0.0464 \text{ inch.}$$

Example 2.—In spiral gearing, the pitch diameter of a gear is found by the formula:

$$D = \frac{N}{P \times \cos \alpha}$$

in which D = pitch diameter of spiral gear,
N = number of teeth in gear,
P = normal diametral pitch,
α = tooth angle of gear.

Assume that in a specific case we know that $N = 20$, $P = 8$, and angle $\alpha = 24$ degrees; find the pitch diameter. Then:

$$D = \frac{20}{8 \times \cos 24^\circ} = \frac{20}{8 \times 0.91355} = 2.7366 \text{ inches.}$$

Example 3.—The formula for finding the lead for which to gear up the milling machine when cutting spiral gears is:

$$L = 3.1416 \times D \times \cot \alpha$$

in which L = the lead for which to gear up the machine,
D = pitch diameter,
α = tooth angle.

Assume that in a specific case we know that $D = 5$, and angle $\alpha = 24$ degrees. Then

$$L = 3.1416 \times 5 \times \cot 24^\circ = 15.708 \times 2.246 = 35.28 \text{ inches.}$$

Example 4.—In a radial ball bearing, if the diameter of the balls, d, and the number of balls, N, are known, the diameter D of the outside or enveloping ball race may be found by the following formula:

$$D = \frac{d}{\sin\left(\frac{180}{N}\right)^\circ} + d$$

Assume that $d = \frac{1}{4}$ inch, and $N = 15$. Then:

$$D = \frac{0.25}{\sin\left(\frac{180}{15}\right)^\circ} + 0.25 = \frac{0.25}{\sin 12^\circ} + 0.25 = \frac{0.25}{0.20791} + 0.25$$
$$= 1.2025 + 0.25 = 1.4525 \text{ inch.}$$

Example 5.—In a sprocket wheel for ordinary link chain, the pitch diameter D can be determined when the number of teeth required, N, the length of the inside oval of the chain link, r, and the diameter of the stock from which the chain link is made, d, are known. The formula used is:

$$D = \sqrt{\left(\frac{r}{\sin (90 + N)^\circ}\right)^2 + \left(\frac{d}{\cos (90 + N)^\circ}\right)^2}$$

If $r = \frac{3}{4}$ inch, $d = \frac{1}{4}$ inch, and $N = 20$ teeth, then:

$$D = \sqrt{\left(\frac{0.75}{\sin 4^\circ\ 30'}\right)^2 + \left(\frac{0.25}{\cos 4^\circ\ 30'}\right)^2} = \sqrt{9.559^2 + 0.251^2}$$

$$= \sqrt{91.437} = 9.562 \text{ inches.}$$

Example 6.—In a Bush roller chain wheel the pitch diameter D of the sprocket wheel can be found if the number of teeth in the sprocket, N, and the pitch P of the chain are decided upon. The formula is:

$$D = \frac{P}{\sin\left(\frac{180}{N}\right)^\circ}$$

Assume that the pitch diameter of a sprocket with 72 teeth, for a chain of ¾ inch pitch, is required. Then $P = \frac{3}{4}$, and $N = 72$; hence $\frac{180}{N} = 2\frac{1}{2}$, and $D = \frac{0.75}{\sin 2^\circ\ 30'} = \frac{0.75}{0.04362} = 17.194$ inches.

Example 7.—The following formula may be used for finding the angle to which to set the dividing head of the milling machine when cutting teeth in the ends of end mills:

$$\cos a = \tan \frac{360}{N} \times \cot \beta$$

in which a = angle to which to set dividing head,
β = included angle of cutter with which teeth are milled,
N = number of teeth in end mill.

Assume that it is required to cut the teeth in the end of an end mill having 12 teeth with a 70-degree angular milling cutter.

$$\cos a = \tan \frac{360}{12} \times \cot 70^\circ = \tan 30^\circ \times \cot 70^\circ$$

$$= 0.57735 \times 0.36397 = 0.21014$$

Having found that $\cos a = 0.21014$, we find that $a = 77^\circ\ 52'$

Example 8.—The angle to which to set the planer head when planing an Acme threading tool having no side clearance, but 15 degrees front clearance, can be determined by the formula:

$$\tan x = \frac{\tan 14^\circ\ 30'}{\cos 15^\circ}$$

in which x = angle to which to set planer head.

Carrying out the calculations, we have:

$$\tan x = \frac{\tan 14^\circ\ 30'}{\cos 15^\circ} = \frac{0.25862}{0.96593} = 0.26774$$

Having found that $\tan x = 0.26774$, we find from the tables that $x = 14^\circ\ 59'$, or practically 15 degrees.

CHAPTER VII

RIGHT-ANGLED TRIANGLES

If the lengths of two sides of a right-angled triangle are known, the third side can be found by a simple calculation. In every right-angled triangle the hypotenuse equals the square root of the sum of the squares of the two sides forming the right angle. If the hypotenuse equals a, and the sides forming the right angle b and c, respectively, as shown in Fig. 19, then:

$$a = \sqrt{b^2 + c^2}$$

Each of the sides b and c can also be found if the hypotenuse and one of the sides are known. The following formulas would then be used:

$$b = \sqrt{a^2 - c^2}$$

$$c = \sqrt{a^2 - b^2}$$

Assume that side b is 18 inches, and side c, 7.5 inches. What is the length of the hypotenuse a?

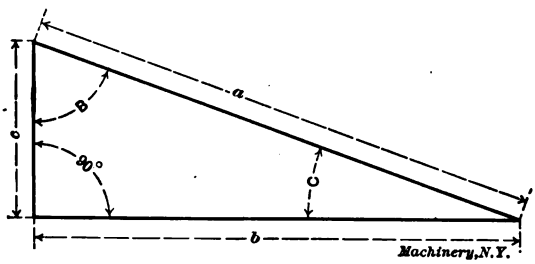


Fig. 19

If we insert the values of b and c in the formula given above for a, we have:

$$a = \sqrt{18^2 + 7.5^2} = \sqrt{18 \times 18 + 7.5 \times 7.5} = \sqrt{324 + 56.25} = \sqrt{380.25} = 19.5$$

Assume that the length of the hypotenuse is 10 inches and that the side c is 6 inches. What is the length of the side b?

Using the formula given above for b, and inserting the values of a and c we have:

$$b = \sqrt{10^2 - 6^2} = \sqrt{10 \times 10 - 6 \times 6} = \sqrt{100 - 36} = \sqrt{64} = 8$$

Thus whenever two sides of a right-angled triangle are given, the third side can always be found by a simple arithmetical calculation. To find the angles, however, it is necessary to use the tables of sines, cosines, tangents and cotangents, as given in the latter part of this book; and if only one side and one of the acute angles are given, the natural trigonometric functions must be used for finding the lengths of the other sides, as explained in the following.

Solution of Right-angled Triangles by Means of the Functions of Angles

In Chapter IV it is stated that the sides and angles of any triangle, which are not known, can be found when:

1. All the three sides,
2. Two sides and one angle, or
3. One side and two angles

are given. In every right-angled triangle one angle, the right or 90-degree angle is, of course, always known. In a right triangle, therefore, the unknown sides and angles can be found when either two sides, or one side and one of the acute angles are known.

The methods of solution of right-angled triangles may be divided into four classes, according to which sides and angles are given or known:

1. Two sides known.
2. The hypotenuse and one acute angle known.
3. One acute angle and its adjacent side known.
4. One acute angle and its opposite side known.

Case 1.—When two sides are known, the third side is found by one of the formulas:

$$a = \sqrt{b^2 + c^2} \qquad (1)$$

$$b = \sqrt{a^2 - c^2} \qquad (2)$$

$$c = \sqrt{a^2 - b^2} \qquad (3)$$

which formulas are given in the first part of this chapter, and in which a is the hypotenuse, and b and c the sides forming the right angle.

The acute angles B and C, Fig. 19, are found by determining either the sine, cosine, tangent or cotangent for the angles, as explained in Chapter IV, and obtaining the angles, expressed in degrees and minutes, from the trigonometric tables. When one angle has been found, the other can also be found directly without reference to the tables, because the sum of the acute angles in a right-angled triangle equals 90 degrees, and if one of them is known, the other must equal 90 degrees minus the known angle. Expressed as formulas this would be:

$$B = 90^\circ - C$$

$$C = 90^\circ - B$$

As an example, assume that the hypotenuse of a right-angled triangle is 5 inches and one of the sides 4 inches, as shown in Fig. 20. Find angles B and C and the length of side c.

The side c is first found by Formula (3) given above, a and b being inserted in this formula as below:

$$c = \sqrt{5^2 - 4^2} = \sqrt{25 - 16} = \sqrt{9} = 3$$

As explained in Chapter IV, the side opposite an angle divided by the hypotenuse, gives the sine of the angle.

Hence

$$\sin C = \frac{3}{5} = 0.6$$

By referring to the trigonometric tables, it will be found that the nearest value to 0.6 in the columns of sines is 0.59995, and the angle corresponding to this value is 36° 52′. Angle C, then equals, 36° 52′.

In the same way

$$\sin B = \frac{4}{5} = 0.8.$$

From the tables we find the nearest value in the columns of sines to be 0.80003, which is the sine of 53° 8′.

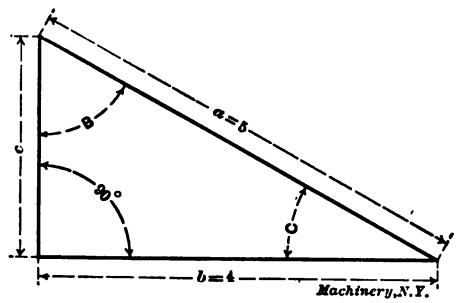


Fig. 20

This last calculation would not have been necessary, because, as has already been mentioned, angle B could have been found directly when angle C was known, by the formula

$$B = 90° - C = 90° - 36° 52' = 53° 8'.$$

It will be noted that either method for finding angle B gives the same result.

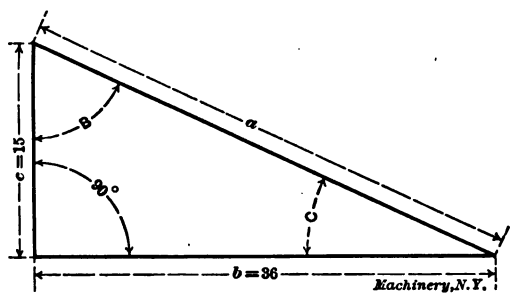


Fig. 21

As a further example, assume that the sides forming the right angle are given as shown in Fig. 21; one is 15 inches and the other is 36 inches. Find the hypotenuse and the angles B and C.

The hypotenuse is found by Formula (1), on page 25, the values of b and c being inserted.

$$a = \sqrt{36^2 + 15^2} = \sqrt{1296 + 225} = \sqrt{1521} = 39.$$

As explained in Chapter IV, the side opposite an angle divided by the side adjacent, equals the tangent of the angle.

Hence

$$\tan B = \frac{36}{15} = 2.4$$

By referring to the tables, it will be found that the nearest value to 2.4 in the columns of tangents is 2.4004, which is the tangent of 67° 23′. Hence $B = 67° 23'$, and

$$C = 90° - B = 90° - 67° 23' = 22° 37'$$

Case 2.—If the hypotenuse and one acute angle are known, the side adjacent to the known angle is found by multiplying the hypotenuse by the cosine of the known angle; the side opposite the known angle is found by multiplying the hypotenuse by the sine of the known angle; and the other acute angle is found by subtracting the known angle from 90 degrees.

We can express this rule by simple formulas. Referring to Fig. 19, if a is the hypotenuse, and B the known angle, then:

$$c = a \times \cos B$$
$$b = a \times \sin B$$
$$C = 90° - B$$

If C is the known angle, then:

$$b = a \times \cos C$$
$$c = a \times \sin C$$
$$B = 90° - C$$

As an example, assume that the hypotenuse $a = 22$ inches, and angle $B = 41° 36'$. Find sides b and c, and angle C. (See Fig. 19.)

By referring to the tables, it will be found that the nearest value to case when angle B is known, we have:

$c = a \times \cos B = 22 \times \cos 41° 36' = 22 \times 0.74780 = 16.4516$ inches.
$b = a \times \sin B = 22 \times \sin 41° 36' = 22 \times 0.66393 = 14.6065$ inches.
$C = 90° - 41° 36' = 48° 24'$.

Case 3.—When one acute angle and its adjacent side are known, the hypotenuse is found by dividing the known side by the cosine of the known angle; the side opposite the known angle is found by multiplying the known adjacent side by the tangent of the known angle; and the other acute angle is found by subtracting the known angle from 90°.

Referring to Fig. 19, we can express this rule by simple formulas. If B is the known angle, and c the known side, adjacent to angle B, then:

$$a = \frac{c}{\cos B} \qquad b = c \times \tan B \qquad C = 90° - B$$

If C is the known angle, and b the known side, adjacent to angle C, then:

$$a = \frac{b}{\cos C} \qquad c = b \times \tan C \qquad B = 90° - C$$

As an example, assume that angle $B = 25° 12'$, and its adjacent side $c = 12$ inches. Find the hypotenuse a, opposite side b, and angle C.

By inserting the known values in the formulas just given for the case where angle B is known, we have:

$$a = \frac{c}{\cos B} = \frac{12}{\cos 25° 12'} = \frac{12}{0.90483} = 13.262 \text{ inches.}$$

$b = c \times \tan B = 12 \times 0.47056 = 5.6467$ inches.

$C = 90° - 25° 12' = 64° 48'$

Case 4.—When one acute angle and the side opposite it are known, the hypotenuse is found by dividing the known side by the sine of the known angle; the side adjacent to the known angle is found by multiplying the known opposite side by the cotangent of the known angle; and the other acute angle is found by subtracting the known angle from 90°.

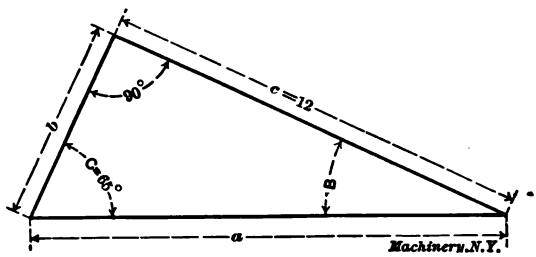


Fig. 22

By referring to Fig. 19, we can express this rule by simple formulas. If B is the known angle, and b the side opposite, which is also known, then:

$$a = \frac{b}{\sin B} \qquad c = b \times \cot B \qquad C = 90° - B$$

If C is the known angle, and c the known side, opposite to angle C, then:

$$a = \frac{c}{\sin C} \qquad b = c \times \cot C \qquad B = 90° - C$$

As an example, assume that angle C equals 65 degrees, and that the length of side c is 12 feet, as shown in Fig. 22. Find the lengths of sides a and b and angle B.

By inserting the known values in the formulas just given for the case when angle C is known, we have:

$$a = \frac{c}{\sin C} = \frac{12}{\sin 65°} = \frac{12}{0.90631} = 13.2405 \text{ inches.}$$

$b = c \times \cot C = 12 \times 0.46631 = 5.5957$ inches.

$B = 90° - 65° = 25°.$

CHAPTER VIII

PROBLEMS FROM PRACTICE

The calculations required in the design of bevel gearing offer abundant examples of the use of the trigonometric functions and the solution of right-angled triangles. The student who is anxious to obtain additional practice, and to whom the practical applications of the formulas given are of especial interest, is, therefore, referred to the book "Spur and Bevel Gearing" published by MACHINERY. In the following, however, a number of practical examples, selected for the purpose of illustration, will also be given.

Example 1.—Fig. 23 shows a section of a United States standard thread. Find a formula for the depth of the thread in terms of the pitch, and calculate the depth of screw threads with 12 and 16 threads per inch.

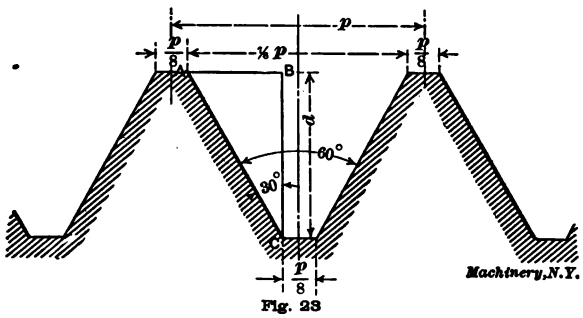


Fig. 23

In the illustration, p is the pitch of the thread. The pitch, of course, equals $\frac{1}{\text{No. of threads per inch.}}$. It is required to find the depth BC of the thread, expressed in terms of the pitch. This depth can be found if we can solve the triangle ABC.

In the U. S. standard thread system there is a flat at the top and bottom of the thread as shown in Fig. 23. The width of this flat is one-eighth of the pitch, as indicated. Hence, side AB of the right-angled triangle ABC equals one-half of ⅞ pitch minus one-half of ⅛ pitch, or $\left(\frac{7}{16} - \frac{1}{16}\right)$ pitch = ⅜ pitch. The angle opposite this side is also known; it is one-half of the total thread angle, or 30 degrees. According to the rules and formulas in the previous chapter, therefore,

$$BC = AB \times \cot 30°$$

If we insert in this formula $BC = d$, $AB = \frac{3}{8}\ p$, and cot $30° = 1.7321$, we have:

$$d = \frac{3}{8}\ p \times 1.7321 = 0.6495\ p$$

in which d = depth of thread,

p = pitch of thread.

We will now find the depth of the thread for 12 and 16 threads per inch. As $p = \dfrac{1}{\text{No. of threads per inch}}$, we have, by inserting the known values in the general formula just found:

$$d = 0.6495 \times \frac{1}{12} = 0.0541 \text{ inch, for 12 threads,}$$

$$d = 0.6495 \times \frac{1}{16} = 0.0406 \text{ inch, for 16 threads.}$$

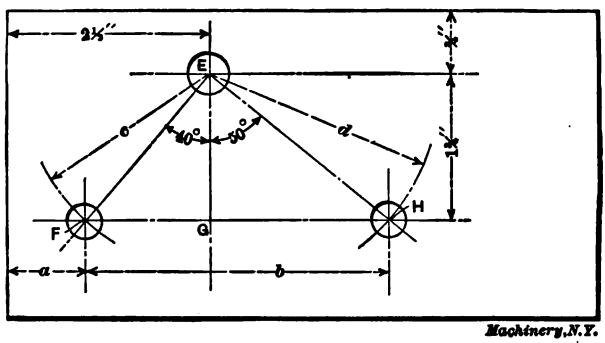


Fig. 24

Example 2.—In laying out a master jig plate, it is required that holes F and H, Fig. 24, shall be on a straight line which is 1¾ inch distant from hole E. The holes must also be on lines making, respectively, 40- and 50-degree angles with line EG, drawn at right angles to the sides of the jig plate through E, as shown in the engraving. Find the dimensions necessary for the toolmaker.

The dimensions which ought to be given the toolmaker in addition to those already given are indicated by a, b, c, and d. The two latter are the radii of the arcs which if struck with E as a center will pass through the centers of F and H. We have here two right-angled triangles EFG and EGH. We know one acute angle in each, and also the length of side EG (1¾ inch) which is mutual to both triangles and which is the side adjacent to the known angle. From the formulas in the preceding chapter we, therefore, have:

$$FG = 1.75 \times \tan 40° = 1.75 \times 0.83910 = 1.4684 \text{ inch.}$$

$$FE = \frac{1.75}{\cos 40°} = \frac{1.75}{0.76604} = 2.2845 \text{ inches.}$$

$$GH = 1.75 \times \tan 50° = 1.75 \times 1.1918 = 2.0856 \text{ inches.}$$

$$EH = \frac{1.75}{\cos 50°} = \frac{1.75}{0.64279} = 2.7225 \text{ inches.}$$

But, by referring to Fig. 24 it will be seen that $FE = c$, $EH = d$, $2\frac{1}{2} - FG = a$, and $FG + GH = b$. Hence

$a = 2.5 - 1.4684 = 1.0316$ inch,

$b = 1.4684 + 2.0856 = 3.5540$ inches,

$c = 2.2845$ inches,

$d = 2.7225$ inches.

Example 3.—If the pitch p of a Bush roller chain is $\frac{3}{4}$ inch, and the sprocket wheel is to have 32 teeth, what will be the pitch diameter of the gear? (See Fig. 25.)

By referring to the engraving, it will be seen that $AD = p = \frac{3}{4}$ inch, and $AC = \frac{1}{2}\ AD = \frac{3}{8}$ inch, in this case. Line AB is the pitch radius or one-half the pitch diameter. Angle α is the angle for one

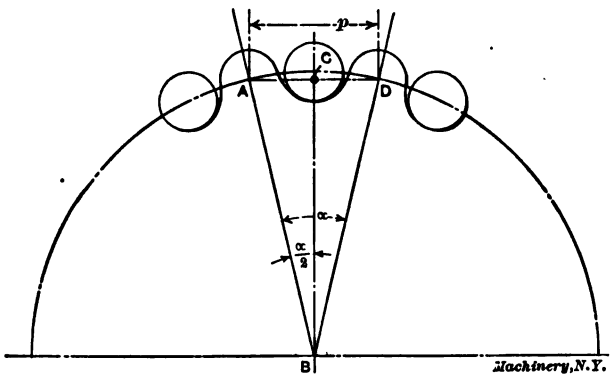


Fig. 25

tooth, and as the whole circle is 360 degrees, α in this case equals $\frac{360}{32} = 11\frac{1}{4}$ degrees, or 11 degrees 15 minutes. One-half of α, then, equals 5 degrees 37 minutes, approximately. We, therefore, have here a right-angled triangle in which we know the length of side AC and the angle opposite it. We want to find the hypotenuse AB. From the formulas in the preceding chapter, we have:

$$AB = \frac{AC}{\sin \frac{\alpha}{2}} = \frac{0.375}{\sin 5° 37'} = \frac{0.375}{0.09787} = 3.832 \text{ inches.}$$

The pitch diameter, then, equals $2 \times 3.832 = 7.664$ inches.

Example 4.—A common method for measuring the width of machine slide dove-tails is indicated diagrammatically in Fig. 26. At A and B are shown carefully ground cylindrical gages of standard dimensions. In the example shown it is required to find what the distance d, measured by micrometers over the gages when these are pushed into the V's of

the dovetail as shown, should be, in order to make sure that the piece is planed to the dimensions given. The diameters of the gages are 0.750 inch.

In order to find dimension d measured over the gages, find dimension KG, Fig. 27, and add twice this length to the distance 3 inches from L to M, in Fig. 26. It will be seen that $KG = KE + EG$; but $KE = \frac{1}{2}$ the gage diameter $= \frac{3}{8}$ inch; and EG is solved from the right-angled

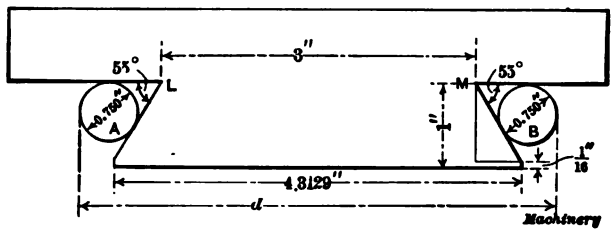


Fig. 26

triangle EGH in which the angle $EHG = 62°30'$, and the side $HG = \frac{1}{2}$ the gage diameter, or $\frac{3}{8}$ inch. That angle EHG equals $62°30'$ is found as follows: Angle $GHN = 90°$; angle $GHF = 90° - 55° = 35°$. Angle $FHE = \frac{1}{2}$ of $55° = 27°30'$; hence, angle $EHG = 35° + 27°30' = 62°30'$. Then,

$EG = HG \times \tan 62°30' = \frac{3}{8} \times 1.921 = 0.7204$ inch.

$KE + EG = 0.375 + 0.7204 = 1.0954$ inch.

$d = 2 \times 1.0954 + 3 = 5.1908$ inches.

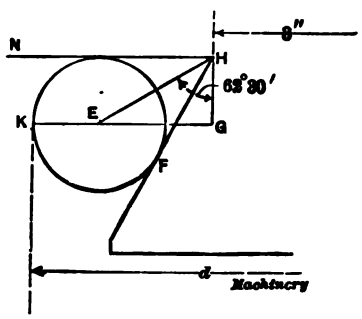


Fig. 27

Example 5.—Small reamers are sometimes provided with flats instead of actual flutes. The diameter of the reamer is, of course, measured over the sharp corners; if the reamer tapers, the taper of the flats will not be the same as the taper of the sharp corners, and the milling machine dividing head must be set to a different angle from that which the cutting edge makes with the center line. A simple formula may be deduced by the aid of trigonometry for finding the angle to which to set the dividing head when milling the flats.

Referring to Fig. 28, in which the reamer is imagined as continued to a sharp point at the end, let

a = angle made by cutting edge with center line,

a_1 = angle made by flat with center line,

N = number of sides of reamer,

T = taper per foot.

Angle β, as shown in the engraving, can be determined by the formula

$$\beta = \frac{360}{2N}$$

as is evident from the illustration.

Angle α_1 is the angle sought. It will be seen that if FE and HE were known, then

$$\tan \alpha_1 = \frac{FE}{HE}$$

But $FE = AE \times \cos \beta$. If we insert this value we have:

$$\tan \alpha_1 = \frac{AE \times \cos \beta}{HE}$$

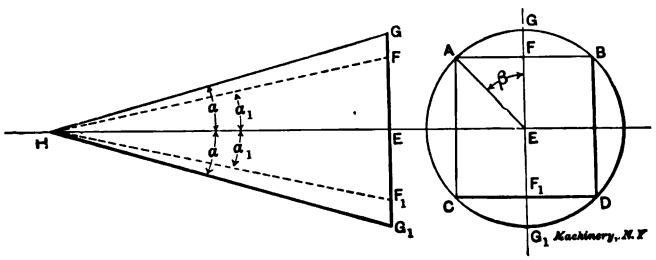


Fig. 28

As $\cos \beta = \cos \frac{360}{2N}$, we have further

$$\tan \alpha_1 = \frac{AE}{HE} \times \cos \frac{360}{2N}$$

The distance AE, however, is one-half of the taper in the distance HE. The taper per inch then is $\frac{2AE}{HE}$, and the taper per foot

$$T = 12 \times \frac{2AE}{HE} = \frac{24AE}{HE}, \text{ or } \frac{T}{24} = \frac{AE}{HE}$$

If we insert $\frac{T}{24}$ in the formula above, we have

$$\tan \alpha_1 = \frac{T}{24} \times \cos \frac{360}{2N}$$

Assume that the taper per foot is ¼ inch, and that a four-sided reamer is required. Find the angle to which to set the index-head.

$$\tan \alpha_1 = \frac{\frac{1}{4}}{24} \times \cos 45^\circ = 0.00736,$$

which gives $\alpha_1 = 25$ minutes.

Example 6.—In Fig. 29 are shown two pulleys of 6 and 12 inches diameter, with a fixed center distance of 5 feet. Find the length of belt required to pass over the two pulleys. The belt is assumed to be perfectly tight.

The length of the belt is made up of the two straight portions AC and BD, tangent to the circles as shown in Fig. 29, and of the arc AEB of the larger pulley and the arc CFD of the smaller pulley. AC and BD are equal. We will first find the length AC. By drawing a line HG from H, the center of the smaller pulley, parallel to AC, we can construct a triangle HGK in which $HG = AC$, and $GK = AK - HC$. That $HG = AC$ is clear from the fact that HC and KA are parallel, both being perpendicular or at right angles to the tangent line AC. The figure $HGAC$ is, therefore, a rectangle, and, hence, opposite sides are equal. HG, therefore, equals AC, and $HC = GA$.

That $GK = AK - HC$ is evident from the fact that $GK = AK - GA$, but as $GA = HC$, it follows that $GK = AK - HC$.

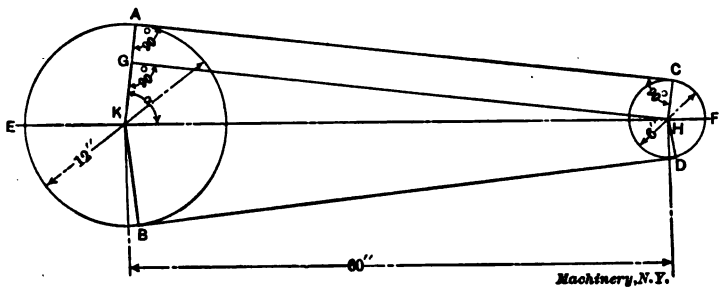


Fig. 29

Now, AK is the radius of the larger pulley, which is one-half its diameter, or 6 inches, and HC is the radius of the smaller pulley or 3 inches. Hence, $GK = 6 - 3 = 3$ inches. $HK = 5$ feet or 60 inches, as given in the problem. We then have here a right-angled triangle in which the hypotenuse $HK = 60$ inches, and one of the sides forming the right angle is 3 inches. Hence, side GH is found by the formula given for this case in the previous chapter, and by inserting the known values we have:

$$GH = \sqrt{60^2 - 3^2} = \sqrt{3600 - 9} = \sqrt{3591} = 59.925.$$

As $GH = AC$, we, therefore, have $AC = 59.925$, and as $AC = BD$, we have $AC + BD = 119.85$ inches. It now remains to find the lengths of the circular arcs AEB and CFD. In order to find these lengths we must first find the number of degrees in these arcs, and to find this, the first step is to find angle α. According to the rules given in Chapter IV,

$$\cos \alpha = \frac{GK}{KH} = \frac{3}{60} = 0.05.$$

From this we find from the trigonometric tables that $\alpha = 87° 8'$.

It will be seen from Fig. 29 that angle $AKE = 180° - \alpha = 180° -$

87° 8′ = 92° 52′. Angle EKB = angle AKE, so that the arc AEB, therefore, is equal to twice angle AKE or

$$\text{arc } AEB = 2 \times 92° 52' = 185° 44'$$

The whole circumference of the larger pulley equals $3.1416 \times 12 = 37.699$ inches. As the whole circumference is 360 degrees, its length in inches is to the length of arc AEB as 360° is to 185° 44′, or

$$\frac{37.699}{\text{arc } AEB} = \frac{360°}{185° 44'}$$

Transposing this expression, we have

$$\text{arc } AEB = \frac{37.699 \times 185° 44'}{360°}$$

Before we can carry out this calculation we must transform 44 minutes to decimals of a degree. As 44 minutes equals 44/60 of a degree, this, changed to a decimal fraction equals $\frac{44}{60} = 0.73$, and 185° 44′ equals 185.73 degrees. Then:

$$\text{arc } AEB = \frac{37.699 \times 185.73}{360} = 19.45 \text{ inches.}$$

Now, to find arc CFD, angle CHF is first determined. This angle equals angle GKH or α, because AK and CH are parallel lines. Hence arc $CFD = 2 \times$ angle $\alpha = 2 \times 87° 8' = 174° 16'$. Now, proceeding as before we have:

$3.1416 \times 6 = 18.8496 =$ circumference of small pulley.

$$\frac{18.8496}{\text{arc } CFD} = \frac{360°}{174° 16'}$$

Transposing this and changing 16 minutes to decimals of a degree, gives us:

$$\text{arc } CFD = \frac{18.8496 \times 174.27}{360} = 9.12 \text{ inches.}$$

The total length of the belt, then, equals

$$119.85 + 19.45 + 9.12 = 148.42 \text{ inches.}$$

CHAPTER IX

SOLUTION OF OBLIQUE-ANGLED TRIANGLES

The methods used in the solution of oblique triangles—that is, triangles, no one of whose angles is a right angle—differ according to which parts are known and which are to be found. The problems which present themselves may be divided into four classes:

1. Two angles and one side known.
2. Two sides and the angle included between them known.
3. Two sides and the angle opposite one of them known.
4. The three sides known.

1. Two Angles and One Side Known

Assume that the angles A and B in Fig. 30 are given as shown, and that side a is 5 inches. Find angle C, sides b and c, and the area of the triangle.

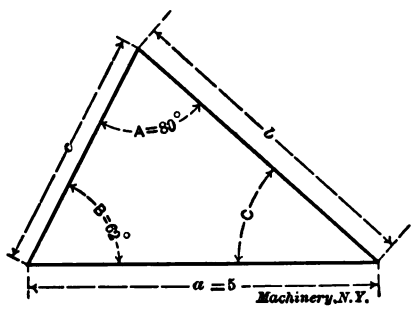


Fig. 30

As the sum of the three angles in a triangle always equals 180 degrees, angle C can be found directly when angles A and B are given, by subtracting the sum of these angles from 180 degrees. Angle A = 80 degrees and B = 62 degrees; therefore,

$$C = 180° - (80° + 62°) = 180° - 142° = 38°$$

For finding the sides b and c the following rule is used: *The side to be found equals the known side multiplied by the sine of the angle opposite the side to be found, and the product divided by the sine of the angle opposite the known side.*

To find side b, for example, multiply the known side a by the sine of angle B, and divide the product by the sine of angle A. Written as a formula this would be:

$$b = \frac{a \times \sin B}{\sin A} \qquad (4)$$

In the same way

$$c = \frac{a \times \sin C}{\sin A} \qquad (5)$$

If we insert the known values for side a and the angles in these formulas, we have:

$$b = \frac{5 \times \sin 62°}{\sin 80°} = \frac{5 \times 0.88295}{0.98481} = 4.483 \text{ inches.}$$

$$c = \frac{5 \times \sin 38°}{\sin 80°} = \frac{5 \times 0.61566}{0.98481} = 3.126 \text{ inches.}$$

Now all the sides and angles are known, and it only remains to find the area of the triangle. This is found by the following rule: *The area of a triangle equals one-half the product of two of its sides multiplied by the sine of the angle between them.* (The area of a triangle may also be found by taking one-half of the product of the base and the altitude.)

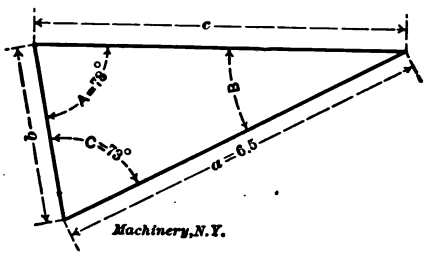


Fig. 31

In the example in Fig. 30, the area, then, equals one-half the product of sides a and b multiplied by the sine of angle C, or, expressed as a formula:

$$\text{Area} = \frac{a \times b \times \sin C}{2} \qquad (6)$$

Inserting the known values for a, b, and C in this formula we have:

$$\text{Area} = \frac{5 \times 4.483 \times \sin 38°}{2} = \frac{5 \times 4.483 \times 0.61566}{2} =$$

$$\frac{13.8000}{2} = 6.9 \text{ square inches.}$$

All the required quantities in this triangle have now been found.

Examples for Practice

Example 1.—In Fig. 31 is shown a triangle of which one side is 6.5 feet, and the two angles A and C (78 and 73 degrees, respectively) are given. Call the sides a, b and c, as shown. Find angle B, sides b and c, and the area.

First find angle B. Using the same method as explained for finding angle C in the previous example, we have:

$$B = 180° - (78° + 73°) = 180° - 151° = 29°.$$

For finding sides b and c use the rule or formulas previously given, inserting the values given in this example:

$$b = \frac{a \times \sin B}{\sin A} = \frac{6.5 \times \sin 29°}{\sin 78°} = \frac{6.5 \times 0.48481}{0.97815}$$

$$= \frac{3.151265}{0.97815} = 3.222 \text{ feet.}$$

$$c = \frac{a \times \sin C}{\sin A} = \frac{6.5 \times \sin 73°}{\sin 78°} = \frac{6.5 \times 0.95630}{0.97815}$$

$$= \frac{6.21595}{0.97815} = 6.355 \text{ feet.}$$

According to the given rule and formula, the area is finally found as below:

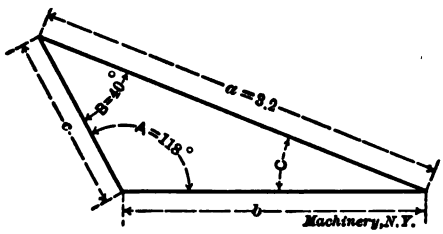


Fig. 32

$$\text{Area} = \frac{a \times b \times \sin C}{2} = \frac{6.5 \times 3.222 \times \sin 73°}{2}$$

$$= \frac{6.5 \times 3.222 \times 0.95630}{2} = \frac{20.027}{2} = 10.013 \text{ square feet.}$$

Example 2.—In Fig. 32, side a equals 3.2 inches, angle A, 118 degrees, and angle B 40 degrees. Find angle C, sides b and c, and the area.

First find angle C.

$$C = 180° - (118° + 40°) = 180° - 158° = 22°$$

Now find side b.

$$b = \frac{3.2 \times \sin 40°}{\sin 118°} = \frac{3.2 \times 0.64279}{0.88295} = 2.330 \text{ inches.}$$

Note, when finding sin 118° from the tables, that sin 118° = sin (180° — 118°) = sin 62° as explained in Chapter V.

Next, find side c.

$$c = \frac{3.2 \times \sin 22°}{\sin 118°} = \frac{3.2 \times 0.37461}{0.88295} = 1.358 \text{ inch.}$$

Finally,

$$\text{Area} = \frac{3.2 \times 2.33 \times \sin 22^\circ}{2} = 1.396 \text{ square inch.}$$

Example 3.—In Fig. 33, side $b = 0.3$ foot, angle $B = 35^\circ\ 40'$, and angle $C = 24^\circ\ 10'$. Find angle A, sides a and c, and the area.

$$A = 180^\circ - (35^\circ\ 40' + 24^\circ\ 10') = 180^\circ - 59^\circ\ 50' = 120^\circ\ 10'.$$

To find side a, use the rule already given, from which we get the formula below:

$$a = \frac{b \times \sin A}{\sin B} = \frac{0.3 \times \sin 120^\circ\ 10'}{\sin 35^\circ\ 40'} = \frac{0.3 \times 0.86457}{0.58307} = 0.445 \text{ foot.}$$

To find side c, use again the same rule, from which we then get:

$$c = \frac{b \times \sin C}{\sin B} = \frac{0.3 \times \sin 24^\circ\ 10'}{\sin 35^\circ\ 40'} = \frac{0.3 \times 0.40939}{0.58307} = 0.211 \text{ foot.}$$

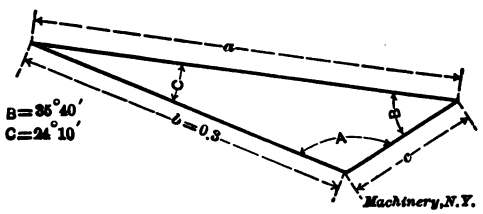


Fig. 33

Note that in this example the formulas for a and c have the same *form* as Formulas (4) and (5) on pages 36 and 37, but as the side b is the known side, instead of a, the side b is brought into the formula instead of a, and angle B instead of angle A. The formulas for a and c in this example are directly deduced from the rule on page 36, for finding the unknown sides.

To find the area, use Formula (6):

$$\text{Area} = \frac{a \times b \times \sin C}{2} = \frac{0.445 \times 0.3 \times \sin 24^\circ\ 10'}{2} =$$

$$\frac{0.445 \times 0.3 \times 0.40939}{2} = 0.027 \text{ square foot.}$$

Summary of Formulas

If the angles of a triangle are called A, B and C, and the sides opposite each of the angles, a, b and c, respectively, as shown in Fig. 30, then, if two angles and one side are known, the remaining angle, the two unknown sides and the area may be found by the formulas below:

$$A = 180^\circ - (B + C) \qquad (7)$$

$$B = 180^\circ - (A + C) \qquad (8)$$

$$C = 180^\circ - (A + B) \qquad (9)$$

$$a = \frac{b \times \sin A}{\sin B} \qquad b = \frac{a \times \sin B}{\sin A} \qquad c = \frac{b \times \sin C}{\sin B}$$

$$a = \frac{c \times \sin A}{\sin C} \qquad b = \frac{c \times \sin B}{\sin C} \qquad c = \frac{a \times \sin C}{\sin A}$$

$$\text{Area} = \frac{a \times b \times \sin C}{2} = \frac{b \times c \times \sin A}{2} = \frac{a \times c \times \sin B}{2}$$

2. Two Sides and the Included Angle Known

Assume that the sides a and b in Fig. 34 are 9 and 8 inches, respectively, as shown, and that the angle C formed by these two sides is 35 degrees. Find angles A and B, side c, and the area of the triangle.

The tangent of angle A is found by the following formula:

$$\tan A = \frac{a \times \sin C}{b - a \times \cos C} \qquad (10)$$

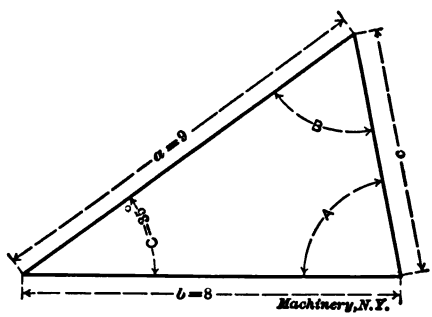


Fig. 34

If the given values of a, b and C are inserted in this formula, we have:

$$\tan A = \frac{9 \times \sin 35°}{8 - 9 \times \cos 35°} = \frac{9 \times 0.57358}{8 - 9 \times 0.81915} =$$

$$\frac{5.16222}{0.62765} = 8.22468.$$

Having now obtained the tangent of angle $A = 8.22468$, we find from the tables that the angle equals 83° 4′.

Now when both angles A and C are known, angle B is found by Formula (8) already given:

$$B = 180° - (A + C) = 180° - (83° 4' + 35°) =$$
$$180° - 118° 4' = 61° 56'$$

Side c is found by Formula (5):

$$c = \frac{a \times \sin C}{\sin A} = \frac{9 \times \sin 35°}{\sin 83° 4'} = \frac{9 \times 0.57358}{0.99269} = 5.2 \text{ inches.}$$

The area is found by Formula (6):

$$\text{Area} = \frac{a \times b \times \sin C}{2} = \frac{9 \times 8 \times 0.57358}{2} = 20.649 \text{ square inches.}$$

All the required quantities of this triangle have now been found.

Example 1.—In Fig. 35, $a = 4$ inches, $b = 3$ inches, and $C = 20$ degrees. Find A, B, c, and the area.

According to Formula (10), we have:

$$\tan A = \frac{a \times \sin C}{b - a \times \cos C} = \frac{4 \times \sin 20°}{3 - 4 \times \cos 20°} = \frac{4 \times 0.34202}{3 - 4 \times 0.93969}$$

$$= \frac{1.36808}{3 - 3.75876}$$

It will be seen that in the denominator of the fraction above, the number to be subtracted from 3 is greater than 3; the numbers are

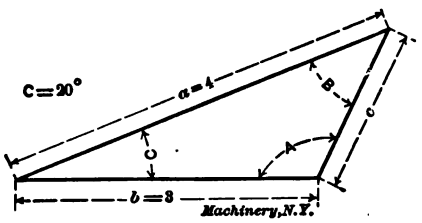


Fig. 35

therefore reversed as explained in Chapter III, 3 being subtracted from 3.75876, the remainder then being negative. Hence:

$$\tan A = \frac{1.36808}{3 - 3.75876} = \frac{1.36808}{-0.75876} = -1.80305$$

The final result is negative because a positive number (1.36808) is divided by a negative number (−0.75876).

In Chapter V it is stated that the tangents of angles greater than 90 degrees and smaller than 180 degrees are negative. In an example in the same chapter is shown how to find an angle whose tangent is negative. Proceeding in the same manner, find in this case the value nearest to 1.80305 in the columns of tangents in the tables. It will be seen that the nearest value is 1.8028, which is the tangent of 60° 59′. As the tangent here is negative, angle A, however, is not 60° 59′, but equals 180° − 60° 59′ = 119° 1′.

Now angle B is found by the formula

$$B = 180° - (A + C) = 180° - (119° 1' + 20°) =$$
$$180° - 139° 1' = 40° 59'.$$

Side c and the area are now found by the same formulas and in the same manner as previously shown.

Example 2.—In Fig. 36, $a = 7$ feet, $b = 4$ feet, and $C = 121$ degrees. Find A, B, c and the area.

Proceeding as in the previous example we have

$$\tan A = \frac{a \times \sin C}{b - a \times \cos C} = \frac{7 \times \sin 121°}{4 - 7 \times \cos 121°}$$

As explained in Chapter V:

$$\sin 121° = \sin (180° - 121°) = \sin 59°, \text{ and}$$
$$\cos 121° = -\cos (180° - 121°) = -\cos 59°$$

Therefore

$$\tan A = \frac{7 \times \sin 121°}{4 - 7 \times \cos 121°} = \frac{7 \times \sin 59°}{4 - 7 \times (-\cos 59°)} =$$
$$\frac{7 \times 0.85717}{4 - 7 \times (-0.51504)} = \frac{6.00019}{4 - (-3.60528)} =$$
$$\frac{6.00019}{4 + 3.60528} = \frac{6.00019}{7.60528} = 0.78895$$

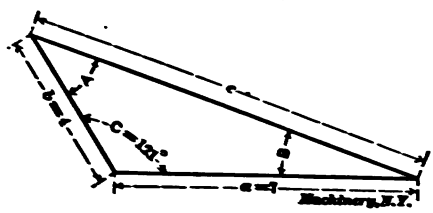


Fig. 36

The calculation with the negative number (−0.51504) will become clear by comparing the processes above with the rules given in Chapter III. When multiplied by 7, the product 7 × (−0.51504) becomes negative, and equals − 3.60528. As subtracting a negative quantity from a positive quantity is equal to adding the numerical value of the negative number we have:

$$4 - (-3.60528) = 4 + 3.60528 = 7.60528$$

Having found tan A = 0.78895, we find angle A from the tables: $A = 38° 16'$.

Angle B, side c and the area are now found in the same way as previously explained.

Summary of Formulas

If the angles of a triangle are called A, B and C and the sides opposite each of the angles a, b and c, respectively, as shown in Fig. 34, then, if any two sides and the included angle are known, the other angles, the remaining side and the area may be found. One of the angles is first found by any of the formulas below:

$$\tan A = \frac{a \times \sin C}{b - a \times \cos C} \qquad \tan A = \frac{a \times \sin B}{c - a \times \cos B}$$

$$\tan B = \frac{b \times \sin C}{a - b \times \cos C} \qquad \tan B = \frac{b \times \sin A}{c - b \times \cos A}$$

$$\tan C = \frac{c \times \sin B}{a - c \times \cos B} \qquad \tan C = \frac{c \times \sin A}{b - c \times \cos A}$$

The third angle, the remaining side, and the area are then found by using Formulas (4), (5), (6), (7), (8) and (9).

If the unknown angles are not required, but merely the unknown side of the triangle, the following formulas may be employed:

$$a = \sqrt{b^2 + c^2 - 2bc \times \cos A}$$
$$b = \sqrt{a^2 + c^2 - 2ac \times \cos B}$$
$$c = \sqrt{a^2 + b^2 - 2ab \times \cos C}$$

3. Two Sides and One of the Opposite Angles Known

When two sides and the angle opposite one of the given sides are known, two triangles can be drawn which have the sides the required length and the angle opposite one of the sides the required size. In Fig. 37 is shown a triangle in which side a is 2.5 inches, side b, 3.5 inches, and angle A, 32 degrees. Another triangle is shown by dotted lines in the same figure in which sides a and b have the same length as in the triangle drawn by full lines, and angle A opposite side a still remains 32 degrees; but it will be seen that in this triangle the angle B is very much smaller than in the triangle drawn by the full lines. In every case, therefore, when two sides and one of the opposite angles are given, the problem is capable of two solutions, there being two triangles which fill the given requirements. In one of these triangles, the unknown angle opposite a given side is greater than a right angle, and in one it is less than a right angle. When the triangle to be calculated is drawn to the correct shape, it is, therefore, possible to determine from the shape of the triangle which of the two solutions applies. When the triangle is not drawn to the required shape, both solutions must be found and applied to the practical problem requiring the solution of the triangle; it can then

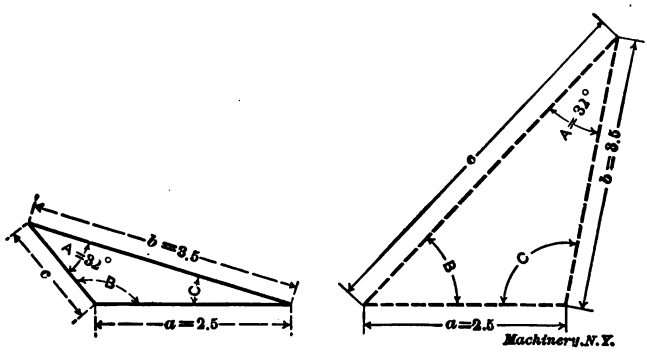


Fig. 37

usually be determined which of the solutions applies to the practical problem in hand.

Example 1.—Assume that the sides a and b in Fig. 38 are 20 and 17 inches, respectively, as shown, and that angle A opposite the known side a is 61 degrees. Find angles B and C, side c, and the area of the triangle.

The angle B opposite the known side b may be found by the following rule: *The sine of the angle opposite one of the known sides equals the product of the side opposite this angle times the sine of the known angle, divided by the side opposite the known angle.*

From this rule we derive the following formula for the sine of angle B:

$$\sin B = \frac{b \times \sin A}{a} \qquad (11)$$

If we insert the known values for sides b and a and angle A in this formula we have:

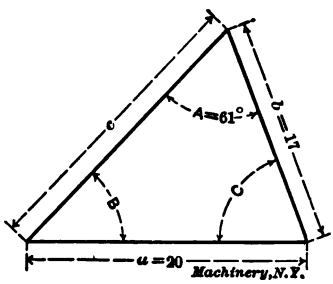


Fig. 38

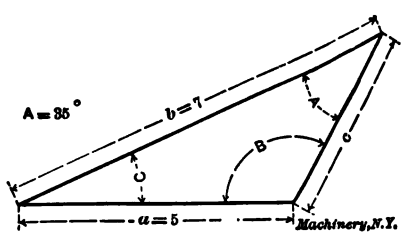


Fig. 39

$$\sin B = \frac{17 \times \sin 61°}{20} = \frac{17 \times 0.87462}{20} = 0.74343.$$

Having sin B = 0.74343, we find from the tables that B = 48° 1′. As it is shown in Fig. 38 that angle B is less than a right angle, the solution found is the one which applies in this case.

Angle C is now found from Formula (9):

$$C = 180° - (A + B) = 180° - (61° + 48° 1') = 70° 59'.$$

Side c is found by Formula (5):

$$c = \frac{a \times \sin C}{\sin A} = \frac{20 \times \sin 70° 59'}{\sin 61°} = \frac{20 \times 0.94542}{0.87462} = 21.62 \text{ inches.}$$

The area is found by Formula (6):

$$\text{Area} = \frac{a \times b \times \sin C}{2} = \frac{20 \times 17 \times \sin 70° 59'}{2} = 160.72 \text{ square inches.}$$

All the required quantities of this triangle have now been found.

Example 2.—In Fig. 39, a = 5 inches, b = 7 inches, and A = 35 degrees. Find B, C, c and the area.

According to the rule and formula in the previous example:

$$\sin B = \frac{b \times \sin A}{a} = \frac{7 \times \sin 35°}{5} = \frac{7 \times 0.57358}{5} = 0.80301$$

Having sin $B = 0.80301$, we find from the tables that $B = 53° 25'$. However, in the present case we see from the figure that B is greater than 90 degrees. The solution obtained is, therefore, not the solution applying to this case. It is explained in Chapter V that the sine of an angle also equals the sine of 180 degrees minus the angle. Therefore, 0.80301 is the sine not only of 53° 25′, but also of 180° — 53° 25′ = 126° 35′. The value of angle B applying to the triangle shown in Fig. 39 is therefore 126° 35′, because of the two values obtained this is the one which is greater than a right angle.

When angle B is found, angle C, side c and the area are found in the same manner as in Example 1.

Example 3.—In Fig. 40, $a = 2$ feet, $b = 3$ feet and $A = 30$ degrees. Find B, C, c and the area.

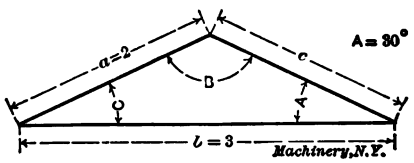


Fig. 40

The sine of angle B is found as in the previous example:

$$\sin B = \frac{b \times \sin A}{a} = \frac{3 \times \sin 30°}{2} = 0.75000$$

Having sin $B = 0.75000$, we find from the tables that $B = 48° 35'$. From Fig. 40 it is apparent, however, that B is greater than 90 degrees, and as 0.75000 is the sine not only of 48° 35′, but also of 180° — 48° 35′ = 131° 25′, angle B in this case equals 131° 25′.

When the angle B is found, angle C, side c and the area are found in the same manner as in Example 1.

Summary of Formulas

If the angles of a triangle are called A, B and C, and the sides opposite each of the angles a, b and c, respectively, as shown in Fig. 37; then if any two sides and one angle opposite one of the known sides are given, the other angles, the remaining side, and the area may be found. The angle opposite the other known side is first found by any of the formulas below:

$$\sin A = \frac{a \times \sin B}{b} \qquad \sin A = \frac{a \times \sin C}{c}$$

$$\sin B = \frac{b \times \sin A}{a} \qquad \sin B = \frac{b \times \sin C}{c}$$

$$\sin C = \frac{c \times \sin A}{a} \qquad \sin C = \frac{c \times \sin B}{b}$$

The third angle, the remaining side and the area are then found by using Formulas (4) to (9) inclusive.

4. Three Sides Known

Example. 1.—In Fig. 41 the three sides a, b and c of the triangle are given; $a = 8$ inches, $b = 9$ inches and $c = 10$ inches. Find the angles A, B and C and the area.

Either of the angles can be found by the formulas given below:

$$\cos A = \frac{b^2 + c^2 - a^2}{2 \times b \times c} \tag{12}$$

$$\cos B = \frac{a^2 + c^2 - b^2}{2 \times a \times c} \tag{13}$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2 \times a \times b} \tag{14}$$

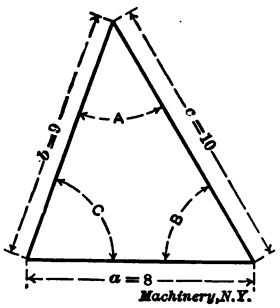


Fig. 41

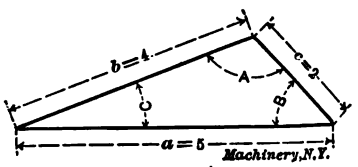


Fig. 42

If we insert the given lengths of the sides in the first of the formulas above we have:

$$\cos A = \frac{9^2 + 10^2 - 8^2}{2 \times 9 \times 10} = \frac{9 \times 9 + 10 \times 10 - 8 \times 8}{2 \times 9 \times 10} = \frac{81 + 100 - 64}{180}$$

$$= \frac{117}{180} = 0.65000$$

Having $\cos A = 0.65000$ we find from the tables that angle $A = 49° 27'$.

Having found angle A, the easiest method for finding angle B is by Formula (11). From this formula we have:

$$\sin B = \frac{b \times \sin A}{a} = \frac{9 \times \sin 49° 27'}{8} = \frac{9 \times 0.75984}{8} = 0.85482$$

Having sin $B = 0.85482$, we find from the tables that $B = 58° 44'$.
Angle C is now found by Formula (9):
$C = 180° - (A + B) = 180° - (49° 27' + 58° 44') = 71° 49'$.
The area is finally found from Formula (6):

$$\text{Area} = \frac{a \times b \times \sin C}{2} = \frac{8 \times 9 \times \sin 71° 49'}{2} = \frac{8 \times 9 \times 0.95006}{2}$$

$= 34.20$ square inches.

Example 2.—In Fig. 42, $a = 5$ inches, $b = 4$ inches and $c = 2$ inches. Find the angles of the triangle.

Using Formula (12), given in Example 1, we have:

$$\cos A = \frac{4^2 + 2^2 - 5^2}{2 \times 4 \times 2} = \frac{16 + 4 - 25}{16} = \frac{20 - 25}{16}$$

It will be seen that in the numerator of the last fraction above, the number to be subtracted from 20 is greater than 20. The numbers are therefore reversed, as explained in Chapter III, 20 being subtracted from 25, the remainder then being negative. Hence:

$$\cos A = \frac{20 - 25}{16} = \frac{-5}{16} = -0.31250$$

The final result is negative, because a negative number (—5) is divided by a positive number (16). In Chapter V it is stated that the cosines of angles greater than 90 degrees and smaller than 180 degrees are negative. In an example in the same chapter is shown how to find the angle whose tangent is negative; an angle whose cosine is negative is found in a similar manner: Find the value nearest to 0.31250 in the columns of cosines in the tables. It will be seen that the nearest value is 0.31261, which is the cosine of 71° 47'. As the cosine here is negative, angle A, however, is not 71° 47' but $=$ 180° — 71° 47' = 108° 13'. Now angle B is found by the formula:

$$\sin B = \frac{b \times \sin A}{a} = \frac{4 \times \sin 108° 13'}{5}$$

As stated in Chapter V, sin 108° 13' = sin (180° — 108° 13') = sin 71° 47'. Hence:

$$\sin B = \frac{4 \times \sin 71° 47'}{5} = \frac{4 \times 0.94988}{5} = 0.75990$$

and $B = 49° 27'$.

Finally, angle C is found by the formula:

$C = 180° - (A + B) = 180° - (108° 13' + 49° 27') = 22° 20'$.

CHAPTER X

SUMMARY OF FORMULAS FOR SOLUTION OF TRIANGLES

In the following will be given a summary of all the required formulas, and the methods of procedure for solving both right- and oblique-angled triangles.

Right-angled Triangles

In all the formulas for right-angled triangles reference is made to Fig. 43, in which the sides and angles are given the same names as in the formulas. Use the formulas in the order given.

1. When the hypotenuse and one of the sides forming the right angle are given, call the hypotenuse a and the known side b. Then:

$$c = \sqrt{a^2 - b^2} \qquad \sin B = \frac{b}{a} \qquad C = 90° - B$$

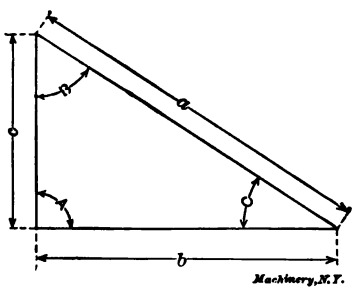


Fig. 43

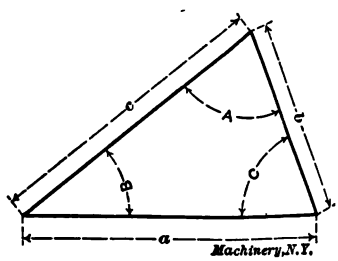


Fig. 44

2. When the two sides forming the right angle are given, call them b and c. Then:

$$a = \sqrt{b^2 + c^2} \qquad \tan B = \frac{b}{c} \qquad C = 90° - B$$

3. When the hypotenuse and one acute angle are given, call the hypotenuse a and the known angle B. Then:

$$c = a \times \cos B \qquad b = a \times \sin B \qquad C = 90° - B$$

4. When one acute angle and its adjacent side are given, call the angle B and the adjacent known side c. Then:

$$a = \frac{c}{\cos B} \qquad b = c \times \tan B \qquad C = 90° - B$$

5. When one acute angle and the side opposite it are given, call the angle B and the known opposite side b. Then:

$$a = \frac{b}{\sin B} \qquad c = b \times \cot B \qquad C = 90° - B$$

The area of all right-angled triangles equals the product of the sides forming the right angle divided by 2; or, referring to Fig. 43:

$$\text{Area} = \frac{b \times c}{2}$$

Oblique-angled Triangles

In all the formulas for oblique-angled triangles reference is made to Fig. 44, in which the sides and angles are given the same names as in the formulas. Use the formulas in the order given.

1. When two angles and one side are given, call the given side a, the angle opposite it A, and the other angle B. Then if A is known:

$$C = 180° - (A + B)$$

$$b = \frac{a \times \sin B}{\sin A}$$

$$c = \frac{a \times \sin C}{\sin A}$$

$$\text{Area} = \frac{a \times b \times \sin C}{2}$$

If B and C are given, but not A, then $A = 180° - (B + C)$, the other formulas being as above.

2. When two sides and the included angle are given, call the given sides a and b and the given angle between them C. Then:

$$\tan A = \frac{a \times \sin C}{b - a \times \cos C}$$

$$B = 180° - (A + C)$$

$$c = \frac{a \times \sin C}{\sin A}$$

$$\text{Area} = \frac{a \times b \times \sin C}{2}$$

3. When two sides and the angle opposite one of the sides are given, call the given angle A, the side opposite it a and the other given side b. Then:

$$\sin B = \frac{b \times \sin A}{a}$$

$$C = 180° - (A + B)$$

$$c = \frac{a \times \sin C}{\sin A}$$

$$\text{Area} = \frac{a \times b \times \sin C}{2}$$

4. When the three sides of a triangle are given, call them a, b and c and the angles opposite them A, B and C, respectively. Then:

$$\cos A = \frac{b^2 + c^2 - a^2}{2 \times b \times c}$$

$$\sin B = \frac{b \times \sin A}{a}$$

$$C = 180^\circ - (A + B)$$

$$\text{Area} = \frac{a \times b \times \sin C}{2}$$

The cases given include all conditions where a solution of the triangle is possible. If all the angles are given, but none of the sides, the triangle may be of any size, but the three sides will be in exact proportion to each other. The formulas below give this relationship:

$$a : b = \sin A : \sin B$$
$$b : c = \sin B : \sin C$$
$$a : c = \sin A : \sin C$$

CHAPTER XI

THE USE OF LOGARITHMS IN SOLVING TRIANGLES

Before undertaking to study the use of logarithms for solving triangles, the student should thoroughly understand the use of logarithms in ordinary numerical examples, as explained in the book "Arithmetic, Elementary Algebra and Logarithms," published by MACHINERY. When the use of logarithms in ordinary calculations is well understood, their application to trigonometric problems is very simple. It is merely a question of finding the logarithm for the function of the angle from the tables at the end of this treatise, and carrying out the calculation in the same manner as with logarithms in general. The heavy-faced figures in the columns headed "Log," in the tables give these logarithms. A few explanatory remarks as to the method in which they are given, will, however, be necessary.

In all cases in these tables, the characteristic is given together with the mantissa. The complete logarithm of the functions, therefore, is found directly from the tables. As however, the values of the natural functions in the three first columns from the left in the tables are always less than 1, the characteristic would always be negative. In order to avoid this negative characteristic, the logarithm as given has had

10 added to its value, so that the actual value of the logarithm for cos 3 deg., for example, is 9.99940 — 10, as is evident if we remember that the logarithm of a number less than 1 must be negative. When using these logarithms in calculations with other logarithms, the calculations can be carried out exactly as explained in the book mentioned on page 50, if when writing down the logarithm taken from the tables we write $\bar{1}.99940$ for 9.99940, $\bar{2}.71940$ for 8.71940, $\bar{3}.30882$ for 7.30882, and so forth, changing the form to that which was made use of in the book previously mentioned. It should be remembered, however, that this change refers only to the three first columns of logarithms. In the fourth column (headed Cot.), the logarithm is given in the exact form in which it is to be used. Of course, if it appears in the divisor of an expression, it must be transformed to its *negative* value, as explained on page 92 of "Arithmetic, Elementary Algebra and Logarithms."

A few examples will give a better idea of the methods to be followed. The student should carefully study these examples, until all the methods employed are perfectly clear to him. The logarithms of ordinary numbers are found from the book previously mentioned, and the logarithms for functions of angles, from the latter part of this book.

Example 1.—Find the area of a triangle where the lengths of two sides are 53 and 82 inches, and the angle between them is 30 degrees.

The area is found by the formula:

$$\text{Area} = \frac{a \times b \times \sin C}{2} = \frac{53 \times 82 \times \sin 30°}{2}$$

Proceed now to find the logarithms:

log 53	$= 1.72428$
log 82	$= 1.91381$
log sin 30°	$= \bar{1}.69897$
— log 2	$= \bar{1}.69897$
	3.03603

The logarithm of the area thus is 3.03603, and from logarithm tables we find by interpolation that the area then equals 1086.5 square inches.

Example 2.—Angles A and C and side a in a triangle are known. (See Fig. 44.) $A = 37° 42'$; $C = 68° 12'$; $a = 12$ inches. Find side c.

The formula for finding side c is:

$$c = \frac{a \times \sin C}{\sin A} = \frac{12 \times \sin 68° 12'}{\sin 37° 42'}$$

When finding the logarithms, note that as log sin 37° 42′ = $\bar{1}.78642$, the negative value of the logarithm equals 0.21358.

log 12	$= 1.07918$
log sin 68° 12′	$= \bar{1}.96778$
— log sin 37° 42′	$= 0.21358$
	1.26054

Thus log c = 1.26054, and hence c = 18.22 inches.

Example 3.—Two sides of a triangle are 9 and 17 inches long. The angle included between them is 32 degrees. Find the angle opposite the side 9 inches long.

The formula by means of which the angle sought can be found is (see Chapter IX):

$$\tan A = \frac{a \times \sin C}{b - a \times \cos C} = \frac{9 \times \sin 32°}{17 - 9 \times \cos 32°}$$

As only multiplications and divisions can be carried out by means of ordinary logarithms, the subtraction in the denominator must be made independently of logarithms; but logarithms can be used for the multiplications and divisions required. The first step will be to find the value of the denominator; we must then first find the product $9 \times \cos 32°$.

$$\begin{aligned} \log 9 &= 0.95424 \\ \log \cos 32° &= \bar{1}.92842 \\ \hline & 0.88266 \end{aligned}$$

Hence $9 \times \cos 32° = 7.6323$, and $17 - 7.6323 = 9.3677$. Therefore,

$$\tan A = \frac{9 \times \sin 32°}{9.3677}$$

$$\begin{aligned} \log 9 &= 0.95424 \\ \log \sin 32° &= \bar{1}.72421 \\ -\log 9.3677 &= \bar{1}.02837 \\ \hline & \bar{1}.70682 \end{aligned}$$

Log tan $A = \bar{1}.70682$, or as given in the tables 9.70682. Hence $A = 26° 59'$.

The columns "d" (difference) and "c. d." (common differences) in the tables, give the differences between consecutive logarithms for use in interpolation in cases where subdivisions of minutes are required. The method used is the same as that used when interpolating between logarithms of ordinary numbers. It is seldom, however, in ordinary shop calculations or in machine design, that finer divisions of the angle than minutes are required.

TABLES OF TRIGONOMETRIC FUNCTIONS

On the following pages are given tables for the natural trigonometric functions, sines, cosines, tangents and cotangents, and their logarithms, for every minute in the angle. The logarithms are printed with heavier face type so that no confusion need result from the fact that both the logarithms and the natural functions are given on the same page. The values of the secants and cosecants are not given in these tables, as they are not generally necessary for the solution of triangles, and all the rules and formulas in the first part of this treatise are given in a form which does not introduce these two functions.

Should, however, the values of these functions be required, they can easily be derived from the tables. The secant is found by dividing 1 by the cosine of the angle, and the cosecant is found by dividing 1 by the sine of the angle. Written as formulas, these rules would be:

$$\sec \alpha = \frac{1}{\cos \alpha}$$

$$\operatorname{cosec} \alpha = \frac{1}{\sin \alpha}$$

Example: Find the secant and cosecant of 15 degrees 42 minutes.

$$\sec 15^\circ 42' = \frac{1}{\cos 15^\circ 42'} = \frac{1}{0.96269} = 1.0387$$

$$\operatorname{cosec} 15^\circ 42' = \frac{1}{\sin 15^\circ 42'} = \frac{1}{0.27060} = 3.6955$$

0°

′	Nat. **Sin** Log.	d.	Nat. **Cos** Log.	Nat. **Tan** Log.	c. d.	Log. **Cot** Nat.	
0	00000 —		1.00000 10.00000	00000 —		— ∞	60
1	029 6.46373	30103	000 0.00000	029 6.46373	30103	3.53627 3437.7	59
2	058 6.76476	17609	000 0.00000	058 6.76476	17609	3.23524 1718.9	58
3	087 6.94085	12494	000 0.00000	087 6.94085	12494	3.05915 1145.9	57
4	116 7.06579	9691	000 0.00000	116 7.06579	9691	2.93421 859.44	56
5	00145 7.16270	7918	1.00000 10.00000	00145 7.16270	7918	2.83730 687.55	55
6	175 7.24188	6694	000 0.00000	175 7.24188	6694	2.75812 572.96	54
7	204 7.30882	5800	000 0.00000	204 7.30882	5800	2.69118 491.11	53
8	233 7.36682	5115	000 0.00000	233 7.36682	5115	2.63318 429.72	52
9	262 7.41797	4576	000 0.00000	262 7.41797	4576	2.58203 381.97	51
10	00291 7.46373	4139	1.00000 10.00000	00291 7.46373	4139	2.53627 343.77	50
11	320 7.50512	3779	99999 0.00000	320 7.50512	3779	2.49488 312.52	49
12	349 7.54291	3476	999 0.00000	349 7.54291	3476	2.45709 286.48	48
13	378 7.57707	3218	999 0.00000	378 7.57707	3219	2.42233 264.44	47
14	407 7.60985	2997	999 0.00000	407 7.60986	2996	2.39014 245.55	46
15	00436 7.63982	2802	99999 10.00000	00436 7.63982	2803	2.36018 229.18	45
16	465 7.66784	2633	999 0.00000	465 7.66785	2633	2.33215 214.86	44
17	495 7.69417	2483	999 9.99999	495 7.69418	2482	2.30582 202.22	43
18	524 7.71900	2348	999 9.99999	524 7.71900	2348	2.28100 190.98	42
19	553 7.74248	2227	998 9.99999	553 7.74248	2228	2.25752 180.93	41
20	00582 7.76475	2119	99998 9.99999	00582 7.76476	2119	2.23524 171.89	40
21	611 7.78594	2021	998 9.99999	611 7.78595	2020	2.21405 163.70	39
22	640 7.80615	1930	998 9.99999	640 7.80615	1931	2.19385 156.26	38
23	669 7.82545	1848	998 9.99999	669 7.82546	1848	2.17454 149.47	37
24	698 7.84393	1773	998 9.99999	698 7.84394	1773	2.15606 143.24	36
25	00727 7.86166	1704	99997 9.99999	00727 7.86167	1704	2.13833 137.51	35
26	756 7.87870	1639	997 9.99999	756 7.87871	1639	2.12129 132.22	34
27	785 7.89509	1579	997 9.99999	785 7.89510	1579	2.10490 127.32	33
28	814 7.91088	1524	997 9.99999	815 7.91089	1524	2.08911 122.77	32
29	844 7.92612	1472	996 9.99998	844 7.92613	1473	2.07387 118.54	31
30	00873 7.94084	1424	99996 9.99998	00873 7.94086	1424	2.05914 114.59	30
31	902 7.95508	1379	996 9.99998	902 7.95510	1379	2.04490 110.89	29
32	931 7.96887	1336	996 9.99998	931 7.96889	1336	2.03111 107.43	28
33	960 7.98223	1297	995 9.99998	960 7.98225	1297	2.01775 104.17	27
34	989 7.99520	1259	995 9.99998	989 7.99522	1259	2.00478 101.11	26
35	01018 8.00779	1223	99995 9.99998	01018 8.00781	1223	1.99219 98.218	25
36	047 8.02002	1190	995 9.99998	047 8.02004	1190	1.97996 95.489	24
37	076 8.03192	1158	994 9.99997	076 8.03194	1159	1.96806 92.908	23
38	105 8.04350	1128	994 9.99997	105 8.04353	1128	1.95647 90.463	22
39	134 8.05478	1100	994 9.99997	135 8.05481	1100	1.94519 88.144	21
40	01164 8.06578	1072	99993 9.99997	01164 8.06581	1072	1.93419 85.940	20
41	193 8.07650	1046	993 9.99997	193 8.07653	1047	1.92347 83.844	19
42	222 8.08696	1022	993 9.99997	222 8.08700	1022	1.91300 81.847	18
43	251 8.09718	999	992 9.99997	251 8.09722	998	1.90278 79.943	17
44	280 8.10717	976	992 9.99996	280 8.10720	976	1.89280 78.126	16
45	01309 8.11693	954	99991 9.99996	01309 8.11696	955	1.88304 76.390	15
46	338 8.12647	934	991 9.99996	338 8.12651	934	1.87340 74.729	14
47	367 8.13581	914	991 9.99996	367 8.13585	915	1.86415 73.139	13
48	396 8.14495	896	990 9.99996	396 8.14500	895	1.85500 71.615	12
49	425 8.15391	877	990 9.99996	425 8.15395	878	1.84605 70.153	11
50	01454 8.16268	860	99989 9.99995	01455 8.16273	860	1.83727 68.750	10
51	483 8.17128	843	989 9.99995	484 8.17133	843	1.82867 67.402	9
52	513 8.17971	827	989 9.99995	513 8.17976	828	1.82024 66.105	8
53	542 8.18798	812	988 9.99995	542 8.18804	812	1.81196 64.858	7
54	571 8.19610	797	988 9.99995	571 8.19616	797	1.80384 63.657	6
55	01600 8.20407	782	99987 9.99994	01600 8.20413	782	1.79587 62.499	5
56	629 8.21189	769	987 9.99994	629 8.21195	769	1.78805 61.383	4
57	658 8.21958	755	986 9.99994	658 8.21964	756	1.78036 60.306	3
58	687 8.22713	743	986 9.99994	687 8.22720	742	1.77280 59.266	2
59	716 8.23456	730	985 9.99994	716 8.23462	730	1.76538 58.261	1
60	745 8.24186		985 9.99993	746 8.24192		1.75808 57.290	0
	Nat. **Cos** Log.	d.	Nat. **Sin** Log.	Nat. **Cot** Log.	c. d.	Log. **Tan** Nat.	′

89°

1°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	01745	8.24186	717	99985	9.99993	01746	8.24192	718	1.75808	57.290	60
1	774	8.24903	706	984	9.99993	775	8.24910	706	1.75090	56.351	59
2	803	8.25609	695	984	9.99993	804	8.25616	696	1.74384	55.442	58
3	832	8.26304	684	983	9.99993	833	8.26312	684	1.73688	54.561	57
4	862	8.26988	673	983	9.99992	862	8.26996	673	1.73004	53.709	56
5	01891	8.27661	663	99982	9.99992	01891	8.27669	663	1.72331	52.882	55
6	920	8.28324	653	982	9.99992	920	8.28332	654	1.71668	.081	54
7	949	8.28977	644	981	9.99992	949	8.28986	643	1.71014	51.303	53
8	978	8.29621	634	980	9.99992	978	8.29629	634	1.70371	50.549	52
9	02007	8.30255	624	980	9.99991	02007	8.30263	625	1.69737	49.816	51
10	02036	8.30879	616	99979	9.99991	02036	8.30888	617	1.69112	49.104	50
11	065	8.31495	608	979	9.99991	066	8.31505	607	1.68495	48.412	49
12	094	8.32103	599	978	9.99990	095	8.32112	599	1.67888	47.740	48
13	123	8.32702	590	977	9.99990	124	8.32711	591	1.67289	.085	47
14	152	8.33292	583	977	9.99990	153	8.33302	584	1.66698	46.449	46
15	02181	8.33875	575	99976	9.99990	02182	8.33886	575	1.66114	45.829	45
16	211	8.34450	568	976	9.99989	211	8.34461	568	1.65539	.226	44
17	240	8.35018	560	975	9.99989	240	8.35029	561	1.64971	44.639	43
18	269	8.35578	553	974	9.99989	269	8.35590	553	1.64410	.066	42
19	298	8.36131	547	974	9.99989	298	8.36143	546	1.63857	43.508	41
20	02327	8.36678	539	99973	9.99988	02328	8.36689	540	1.63311	42.964	40
21	356	8.37217	533	972	9.99988	357	8.37229	533	1.62771	.433	39
22	385	8.37750	526	972	9.99988	386	8.37762	527	1.62238	41.916	38
23	414	8.38276	520	971	9.99987	415	8.38289	520	1.61711	.411	37
24	443	8.38796	514	970	9.99987	444	8.38809	514	1.61191	40.917	36
25	02472	8.39310	508	99969	9.99987	02473	8.39323	509	1.60677	40.436	35
26	501	8.39818	502	969	9.99986	502	8.39832	502	1.60168	39.965	34
27	530	8.40320	496	968	9.99986	531	8.40334	496	1.59666	.506	33
28	560	8.40816	491	967	9.99986	560	8.40830	491	1.59170	.057	32
29	589	8.41307	485	966	9.99985	589	8.41321	486	1.58679	38.618	31
30	02618	8.41792	480	99966	9.99985	02619	8.41807	480	1.58193	38.188	30
31	647	8.42272	474	965	9.99985	648	8.42287	475	1.57713	37.769	29
32	676	8.42746	470	964	9.99984	677	8.42762	470	1.57238	.358	28
33	705	8.43216	464	963	9.99984	706	8.43232	464	1.56768	36.956	27
34	734	8.43680	459	963	9.99984	735	8.43696	460	1.56304	.563	26
35	02763	8.44139	455	99962	9.99983	02764	8.44156	455	1.55844	36.178	25
36	792	8.44594	450	961	9.99983	793	8.44611	450	1.55389	35.801	24
37	821	8.45044	445	960	9.99983	822	8.45061	446	1.54939	.431	23
38	850	8.45489	441	959	9.99982	851	8.45507	441	1.54493	.070	22
39	879	8.45930	436	959	9.99982	881	8.45948	437	1.54052	34.715	21
40	02908	8.46366	433	99958	9.99982	02910	8.46385	432	1.53615	34.368	20
41	938	8.46799	427	957	9.99981	939	8.46817	428	1.53183	.027	19
42	967	8.47226	424	956	9.99981	968	8.47245	424	1.52755	33.694	18
43	996	8.47650	419	955	9.99981	997	8.47669	420	1.52331	.366	17
44	03025	8.48069	416	954	9.99980	03026	8.48089	416	1.51911	.045	16
45	03054	8.48485	411	99953	9.99980	03055	8.48505	412	1.51495	32.730	15
46	083	8.48896	408	952	9.99979	084	8.48917	408	1.51083	.421	14
47	112	8.49304	404	952	9.99979	114	8.49325	404	1.50675	.118	13
48	141	8.49708	400	951	9.99979	143	8.49729	401	1.50271	31.821	12
49	170	8.50108	396	950	9.99978	172	8.50130	397	1.49870	.528	11
50	03199	8.50504	393	99949	9.99978	03201	8.50527	393	1.49473	31.242	10
51	228	8.50897	390	948	9.99977	230	8.50920	390	1.49080	30.960	9
52	257	8.51287	386	947	9.99977	259	8.51310	386	1.48690	.683	8
53	286	8.51673	382	946	9.99977	288	8.51696	383	1.48304	.412	7
54	316	8.52055	379	945	9.99976	317	8.52079	380	1.47921	.145	6
55	03345	8.52434	376	99944	9.99976	03346	8.52459	376	1.47541	29.882	5
56	374	8.52810	373	943	9.99975	376	8.52835	373	1.47165	.624	4
57	403	8.53183	369	942	9.99975	405	8.53208	370	1.46792	.371	3
58	432	8.53552	367	941	9.99974	434	8.53578	367	1.46422	.122	2
59	461	8.53919	363	940	9.99974	463	8.53945	363	1.46055	28.877	1
60	490	8.54282		939	9.99974	492	8.54308		1.45692	.636	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

88°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	′
0	03490	8.54282	360	99939	9.99974	03492	8.54308	361	1.45692	28.636	60
1	519	8.54642	357	938	9.99973	521	8.54669	358	1.45331	.399	59
2	548	8.54999	355	937	9.99973	550	8.55027	355	1.44973	.166	58
3	577	8.55354	351	936	9.99972	579	8.55382	352	1.44618	27.937	57
4	606	8.55705	349	935	9.99972	609	8.55734	349	1.44266	.712	56
5	03635	8.56054	346	99934	9.99971	03638	8.56083	346	1.43917	27.490	55
6	664	8.56400	343	933	9.99971	667	8.56429	344	1.43571	.271	54
7	693	8.56743	341	932	9.99970	696	8.56773	341	1.43227	.057	53
8	723	8.57084	337	931	9.99970	725	8.57114	338	1.42886	26.845	52
9	752	8.57421	336	930	9.99969	754	8.57452	336	1.42548	.637	51
10	03781	8.57757	332	99929	9.99969	03783	8.57788	333	1.42212	26.432	50
11	810	8.58089	330	927	9.99968	812	8.58121	330	1.41879	.230	49
12	839	8.58419	328	926	9.99968	842	8.58451	328	1.41549	.031	48
13	868	8.58747	325	925	9.99967	871	8.58779	326	1.41221	25.835	47
14	897	8.59072	323	924	9.99967	900	8.59105	323	1.40895	.642	46
15	03926	8.59395	320	99923	9.99967	03929	8.59428	321	1.40572	25.452	45
16	955	8.59715	318	922	9.99966	958	8.59749	319	1.40251	.264	44
17	984	8.60033	316	921	9.99966	987	8.60068	316	1.39932	.080	43
18	04013	8.60349	313	919	9.99965	04016	8.60384	314	1.39616	24.898	42
19	042	8.60662	311	918	9.99964	046	8.60698	311	1.39302	.719	41
20	04071	8.60973	309	99917	9.99964	04075	8.61009	310	1.38991	24.542	40
21	100	8.61282	307	916	9.99963	104	8.61319	307	1.38681	.368	39
22	129	8.61589	305	915	9.99963	133	8.61626	305	1.38374	.196	38
23	159	8.61894	302	913	9.99962	162	8.61931	303	1.38069	.026	37
24	188	8.62196	301	912	9.99962	191	8.62234	301	1.37766	23.859	36
25	04217	8.62497	298	99911	9.99961	04220	8.62535	299	1.37465	23.695	35
26	246	8.62795	296	910	9.99961	250	8.62834	297	1.37166	.532	34
27	275	8.63091	294	909	9.99960	279	8.63131	295	1.36869	.372	33
28	304	8.63385	293	907	9.99960	308	8.63426	292	1.36574	.214	32
29	333	8.63678	290	906	9.99959	337	8.63718	291	1.36282	.058	31
30	04362	8.63968	288	99905	9.99959	04366	8.64009	289	1.35991	22.904	30
31	391	8.64256	287	904	9.99958	395	8.64298	287	1.35702	.752	29
32	420	8.64543	284	902	9.99958	424	8.64585	285	1.35415	.602	28
33	449	8.64827	283	901	9.99957	454	8.64870	284	1.35130	.454	27
34	478	8.65110	281	900	9.99956	483	8.65154	281	1.34846	.308	26
35	04507	8.65391	279	99898	9.99956	04512	8.65435	280	1.34565	22.164	25
36	536	8.65670	277	897	9.99955	541	8.65715	278	1.34285	.022	24
37	565	8.65947	276	896	9.99955	570	8.65993	276	1.34007	21.881	23
38	594	8.66223	274	894	9.99954	599	8.66269	274	1.33731	.743	22
39	623	8.66497	272	893	9.99954	628	8.66543	273	1.33457	.606	21
40	04653	8.66769	270	99892	9.99953	04658	8.66816	271	1.33184	21.470	20
41	682	8.67039	269	890	9.99952	687	8.67087	269	1.32913	.337	19
42	711	8.67308	267	889	9.99952	716	8.67356	268	1.32644	.205	18
43	740	8.67575	266	888	9.99951	745	8.67624	266	1.32376	.075	17
44	769	8.67841	263	886	9.99951	774	8.67890	264	1.32110	20.946	16
45	04798	8.68104	263	99885	9.99950	04803	8.68154	263	1.31846	20.819	15
46	827	8.68367	260	883	9.99949	833	8.68417	261	1.31583	.693	14
47	856	8.68627	259	882	9.99949	862	8.68678	260	1.31322	.569	13
48	885	8.68886	258	881	9.99948	891	8.68938	258	1.31062	.446	12
49	914	8.69144	256	879	9.99948	920	8.69196	257	1.30804	.325	11
50	04943	8.69400	254	99878	9.99947	04949	8.69453	255	1.30547	20.206	10
51	972	8.69654	253	876	9.99946	978	8.69708	254	1.30292	.087	9
52	05001	8.69907	252	875	9.99946	05007	8.69962	252	1.30038	19.970	8
53	030	8.70159	250	873	9.99945	037	8.70214	251	1.29786	.855	7
54	059	8.70409	249	872	9.99944	066	8.70465	249	1.29535	.740	6
55	05088	8.70658	247	99870	9.99944	05095	8.70714	248	1.29286	19.627	5
56	117	8.70905	246	869	9.99943	124	8.70962	246	1.29038	.516	4
57	146	8.71151	244	867	9.99942	153	8.71208	245	1.28792	.405	3
58	175	8.71395	243	866	9.99942	182	8.71453	244	1.28547	.296	2
59	205	8.71638	242	864	9.99941	212	8.71697	243	1.28303	.188	1
60	234	8.71880		863	9.99940	241	8.71940		1.28060	.081	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

3°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	05234	8.71880	240	99863	9.99940	05241	8.71940	241	1.28060	19.081	60
1	263	8.72120	239	861	9.99940	270	8.72181	239	1.27819	18.976	59
2	292	8.72359	238	860	9.99939	299	8.72420	239	1.27580	.871	58
3	321	8.72597	237	858	9.99938	328	8.72659	237	1.27341	.768	57
4	350	8.72834	235	857	9.99938	357	8.72896	236	1.27104	.666	56
5	05379	8.73069	234	99855	9.99937	05387	8.73132	234	1.26868	18.564	55
6	408	8.73303	232	854	9.99936	416	8.73366	234	1.26634	.464	54
7	437	8.73535	232	852	9.99936	445	8.73600	232	1.26400	.366	53
8	466	8.73767	230	851	9.99935	474	8.73832	231	1.26168	.268	52
9	495	8.73997	229	849	9.99934	503	8.74063	229	1.25937	.171	51
10	05524	8.74226	228	99847	9.99934	05533	8.74292	229	1.25708	18.075	50
11	553	8.74454	226	846	9.99933	562	8.74521	227	1.25479	17.980	49
12	582	8.74680	226	844	9.99932	591	8.74748	226	1.25252	.886	48
13	611	8.74906	224	842	9.99932	620	8.74974	225	1.25026	.793	47
14	640	8.75130	223	841	9.99931	649	8.75199	224	1.24801	.702	46
15	05669	8.75353	222	99839	9.99930	05678	8.75423	224	1.24577	17.611	45
16	698	8.75575	220	838	9.99929	708	8.75645	222	1.24355	.521	44
17	727	8.75795	220	836	9.99929	737	8.75867	222	1.24133	.431	43
18	756	8.76015	219	834	9.99928	766	8.76087	220	1.23913	.343	42
19	785	8.76234	217	833	9.99927	795	8.76306	219	1.23694	.256	41
20	05814	8.76451	216	99831	9.99926	05824	8.76525	219	1.23475	17.169	40
21	844	8.76667	216	829	9.99926	854	8.76742	217	1.23258	.084	39
22	873	8.76883	214	827	9.99925	883	8.76958	216	1.23042	16.999	38
23	902	8.77097	213	826	9.99924	912	8.77173	215	1.22827	.915	37
24	931	8.77310	212	824	9.99923	941	8.77387	214	1.22613	.832	36
25	05960	8.77522	211	99822	9.99923	05970	8.77600	213	1.22400	16.750	35
26	989	8.77733	210	821	9.99922	999	8.77811	211	1.22189	.668	34
27	06018	8.77943	209	819	9.99921	06029	8.78022	211	1.21978	.587	33
28	047	8.78152	208	817	9.99920	058	8.78232	210	1.21768	.507	32
29	076	8.78360	208	815	9.99920	087	8.78441	209	1.21559	.428	31
30	06105	8.78568	206	99813	9.99919	06116	8.78649	208	1.21351	16.350	30
31	134	8.78774	205	812	9.99918	145	8.78855	206	1.21145	.272	29
32	163	8.78979	204	810	9.99917	175	8.79061	206	1.20939	.195	28
33	192	8.79183	203	808	9.99917	204	8.79266	205	1.20734	.119	27
34	221	8.79386	202	806	9.99916	233	8.79470	204	1.20530	.043	26
35	06250	8.79588	201	99804	9.99915	06262	8.79673	203	1.20327	15.969	25
36	279	8.79789	201	803	9.99914	291	8.79875	202	1.20125	.895	24
37	308	8.79990	199	801	9.99913	321	8.80076	201	1.19924	.821	23
38	337	8.80189	199	799	9.99913	350	8.80277	201	1.19723	.748	22
39	366	8.80388	197	797	9.99912	379	8.80476	199	1.19524	.676	21
40	06395	8.80585	197	99795	9.99911	06408	8.80674	198	1.19326	15.605	20
41	424	8.80782	196	793	9.99910	438	8.80872	198	1.19128	.534	19
42	453	8.80978	195	792	9.99909	467	8.81068	196	1.18932	.464	18
43	482	8.81173	194	790	9.99909	496	8.81264	196	1.18736	.394	17
44	511	8.81367	193	788	9.99908	525	8.81459	195	1.18541	.325	16
45	06540	8.81560	192	99786	9.99907	06554	8.81653	194	1.18347	15.257	15
46	569	8.81752	192	784	9.99906	584	8.81846	193	1.18154	.189	14
47	598	8.81944	190	782	9.99905	613	8.82038	192	1.17962	.122	13
48	627	8.82134	190	780	9.99904	642	8.82230	192	1.17770	.056	12
49	656	8.82324	189	778	9.99904	671	8.82420	190	1.17580	14.990	11
50	06685	8.82513	188	99776	9.99903	06700	8.82610	190	1.17390	14.924	10
51	714	8.82701	187	774	9.99902	730	8.82799	189	1.17201	.860	9
52	743	8.82888	187	772	9.99901	759	8.82987	188	1.17013	.795	8
53	773	8.83075	186	770	9.99900	788	8.83175	188	1.16825	.732	7
54	802	8.83261	185	768	9.99899	817	8.83361	186	1.16639	.669	6
55	06831	8.83446	184	99766	9.99898	06847	8.83547	186	1.16453	14.606	5
56	860	8.83630	183	764	9.99898	876	8.83732	185	1.16268	.544	4
57	889	8.83813	183	762	9.99897	905	8.83916	184	1.16084	.482	3
58	918	8.83996	181	760	9.99896	934	8.84100	184	1.15900	.421	2
59	947	8.84177	181	758	9.99895	963	8.84282	182	1.15718	.361	1
60	976	8.84358		756	9.99894	993	8.84464	182	1.15536	.301	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin Log.	d.	Nat. Cos Log.	Nat. Tan Log.	c.d.	Log. Cot Nat.	
0	06976 8.84358	181	99756 9.99894	06993 8.84464	182	1.15536 14.301	60
1	07005 8.84539	179	754 9.99893	07022 8.84646	180	1.15354 .241	59
2	034 8.84718	179	752 9.99892	051 8.84826	180	1.15174 .182	58
3	063 8.84897	178	750 9.99891	080 8.85006	179	1.14994 .124	57
4	092 8.85075	177	748 9.99891	110 8.85185	178	1.14815 .065	56
5	07121 8.85252	177	99746 9.99890	07139 8.85363	177	1.14637 14.008	55
6	150 8.85429	176	744 9.99889	168 8.85540	177	1.14460 13.951	54
7	179 8.85605	175	742 9.99888	197 8.85717	176	1.14283 .894	53
8	208 8.85780	175	740 9.99887	227 8.85893	176	1.14107 .838	52
9	237 8.85955	173	738 9.99886	256 8.86069	174	1.13931 .782	51
10	07266 8.86128	173	99736 9.99885	07285 8.86243	174	1.13757 13.727	50
11	295 8.86301	173	734 9.99884	314 8.86417	174	1.13583 .672	49
12	324 8.86474	171	731 9.99883	344 8.86591	172	1.13409 .617	48
13	353 8.86645	171	729 9.99882	373 8.86763	172	1.13237 .563	47
14	382 8.86816	171	727 9.99881	402 8.86935	171	1.13065 .510	46
15	07411 8.86987	169	99725 9.99880	07431 8.87106	171	1.12894 13.457	45
16	440 8.87156	169	723 9.99879	461 8.87277	170	1.12723 .404	44
17	469 8.87325	169	721 9.99879	490 8.87447	169	1.12553 .352	43
18	498 8.87494	167	719 9.99878	519 8.87616	169	1.12384 .300	42
19	527 8.87661	168	716 9.99877	548 8.87785	168	1.12215 .248	41
20	07556 8.87829	166	99714 9.99876	07578 8.87953	167	1.12047 13.197	40
21	585 8.87995	166	712 9.99875	607 8.88120	167	1.11880 .146	39
22	614 8.88161	165	710 9.99874	636 8.88287	166	1.11713 .096	38
23	643 8.88326	164	708 9.99873	665 8.88453	165	1.11547 .046	37
24	672 8.88490	164	705 9.99872	695 8.88618	165	1.11382 12.996	36
25	07701 8.88654	163	99703 9.99871	07724 8.88783	165	1.11217 12.947	35
26	730 8.88817	163	701 9.99870	753 8.88948	163	1.11052 .898	34
27	759 8.88980	162	699 9.99869	782 8.89111	163	1.10889 .850	33
28	788 8.89142	162	696 9.99868	812 8.89274	163	1.10726 .801	32
29	817 8.89304	160	694 9.99867	841 8.89437	161	1.10563 .754	31
30	07846 8.89464	161	99692 9.99866	07870 8.89598	162	1.10402 12.706	30
31	875 8.89625	159	689 9.99865	899 8.89760	160	1.10240 .659	29
32	904 8.89784	159	687 9.99864	929 8.89920	160	1.10080 .612	28
33	933 8.89943	159	685 9.99863	958 8.90080	160	1.09920 .566	27
34	962 8.90102	158	683 9.99862	987 8.90240	159	1.09760 .520	26
35	07991 8.90260	157	99680 9.99861	08017 8.90399	158	1.09601 12.474	25
36	08020 8.90417	157	678 9.99860	046 8.90557	158	1.09443 .429	24
37	049 8.90574	156	676 9.99859	075 8.90715	157	1.09285 .384	23
38	078 8.90730	155	673 9.99858	104 8.90872	157	1.09128 .339	22
39	107 8.90885	155	671 9.99857	134 8.91029	156	1.08971 .295	21
40	08136 8.91040	155	99668 9.99856	08163 8.91185	155	1.08815 12.251	20
41	165 8.91195	154	666 9.99855	192 8.91340	155	1.08660 .207	19
42	194 8.91349	153	664 9.99854	221 8.91495	155	1.08505 .163	18
43	223 8.91502	153	661 9.99853	251 8.91650	153	1.08350 .120	17
44	252 8.91655	152	659 9.99852	280 8.91803	154	1.08197 .077	16
45	08281 8.91807	152	99657 9.99851	08309 8.91957	153	1.08043 12.035	15
46	310 8.91959	151	654 9.99850	339 8.92110	152	1.07890 11.992	14
47	339 8.92110	151	652 9.99848	368 8.92262	152	1.07738 .950	13
48	368 8.92261	150	649 9.99847	397 8.92414	151	1.07586 .909	12
49	397 8.92411	150	647 9.99846	427 8.92565	151	1.07435 .867	11
50	08426 8.92561	149	99644 9.99845	08456 8.92716	150	1.07284 11.826	10
51	455 8.92710	149	642 9.99844	485 8.92866	150	1.07134 .785	9
52	484 8.92859	148	639 9.99843	514 8.93016	149	1.06984 .745	8
53	513 8.93007	147	637 9.99842	544 8.93165	148	1.06835 .705	7
54	542 8.93154	147	635 9.99841	573 8.93313	149	1.06687 .664	6
55	08571 8.93301	147	99632 9.99840	08602 8.93462	147	1.06538 11.625	5
56	600 8.93448	146	630 9.99839	632 8.93609	147	1.06391 .585	4
57	629 8.93594	146	627 9.99838	661 8.93756	147	1.06244 .546	3
58	658 8.93740	145	625 9.99837	690 8.93903	146	1.06097 .507	2
59	687 8.93885	145	622 9.99836	720 8.94049	146	1.05951 .468	1
60	716 8.94030		619 9.99834	749 8.94195		1.05805 .430	0
	Nat. Cos Log.	d.	Nat. Sin Log.	Nat. Cot Log.	c.d.	Log. Tan Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	′
0	08716	8.94030	144	99619	9.99834	08749	8.94195	145	1.05805	11.430	60
1	745	8.94174	143	617	9.99833	778	8.94340	145	1.05660	.392	59
2	774	8.94317	144	614	9.99832	807	8.94485	145	1.05515	.354	58
3	803	8.94461	142	612	9.99831	837	8.94630	143	1.05370	.316	57
4	831	8.94603	143	609	9.99830	866	8.94773	144	1.05227	.279	56
5	08860	8.94746	141	99607	9.99829	08895	8.94917	143	1.05083	11.242	55
6	889	8.94887	142	604	9.99828	925	8.95060	142	1.04940	.205	54
7	918	8.95029	141	602	9.99827	954	8.95202	142	1.04798	.168	53
8	947	8.95170	140	599	9.99825	983	8.95344	142	1.04656	.132	52
9	976	8.95310	140	596	9.99824	09013	8.95486	141	1.04514	.095	51
10	09005	8.95450	139	99594	9.99823	09042	8.95627	140	1.04373	11.059	50
11	034	8.95589	139	591	9.99822	071	8.95767	141	1.04233	.024	49
12	063	8.95728	139	588	9.99821	101	8.95908	139	1.04092	10.988	48
13	092	8.95867	138	586	9.99820	130	8.96047	140	1.03953	.953	47
14	121	8.96005	138	583	9.99819	159	8.96187	138	1.03813	.918	46
15	09150	8.96143	137	99580	9.99817	09189	8.96325	139	1.03675	10.883	45
16	179	8.96280	137	578	9.99816	218	8.96464	138	1.03536	.848	44
17	208	8.96417	136	575	9.99815	247	8.96602	137	1.03398	.814	43
18	237	8.96553	136	572	9.99814	277	8.96739	138	1.03261	.780	42
19	266	8.96689	136	570	9.99813	306	8.96877	136	1.03123	.746	41
20	09295	8.96825	135	99567	9.99812	09335	8.97013	137	1.02987	10.712	40
21	324	8.96960	135	564	9.99810	365	8.97150	135	1.02850	.678	39
22	353	8.97095	134	562	9.99809	394	8.97285	136	1.02715	.645	38
23	382	8.97229	134	559	9.99808	423	8.97421	135	1.02579	.612	37
24	411	8.97363	133	556	9.99807	453	8.97556	135	1.02444	.579	36
25	09440	8.97496	133	99553	9.99806	09482	8.97691	134	1.02309	10.546	35
26	469	8.97629	133	551	9.99804	511	8.97825	134	1.02175	.514	34
27	498	8.97762	132	548	9.99803	541	8.97959	133	1.02041	.481	33
28	527	8.97894	132	545	9.99802	570	8.98092	133	1.01908	.449	32
29	556	8.98026	131	542	9.99801	600	8.98225	133	1.01775	.417	31
30	09585	8.98157	131	99540	9.99800	09629	8.98358	132	1.01642	10.385	30
31	614	8.98288	131	537	9.99798	658	8.98490	132	1.01510	.354	29
32	642	8.98419	130	534	9.99797	688	8.98622	131	1.01378	.322	28
33	671	8.98549	130	531	9.99796	717	8.98753	131	1.01247	.291	27
34	700	8.98679	129	528	9.99795	746	8.98884	131	1.01116	.260	26
35	09729	8.98808	129	99526	9.99793	09776	8.99015	130	1.00985	10.229	25
36	758	8.98937	129	523	9.99792	805	8.99145	130	1.00855	.199	24
37	787	8.99066	128	520	9.99791	834	8.99275	130	1.00725	.168	23
38	816	8.99194	128	517	9.99790	864	8.99405	129	1.00595	.138	22
39	845	8.99322	128	514	9.99788	893	8.99534	128	1.00466	.108	21
40	09874	8.99450	127	99511	9.99787	09923	8.99662	129	1.00338	10.078	20
41	903	8.99577	127	508	9.99786	952	8.99791	128	1.00209	.048	19
42	932	8.99704	126	506	9.99785	981	8.99919	127	1.00081	.019	18
43	961	8.99830	126	503	9.99783	10011	9.00046	128	0.99954	9.9893	17
44	990	8.99956	126	500	9.99782	040	9.00174	127	0.99826	601	16
45	10019	9.00082	125	99497	9.99781	10069	9.00301	126	0.99699	9.9310	15
46	048	9.00207	125	494	9.99780	099	9.00427	126	0.99573	021	14
47	077	9.00332	124	491	9.99778	128	9.00553	126	0.99447	9.8734	13
48	106	9.00456	125	488	9.99777	158	9.00679	126	0.99321	448	12
49	135	9.00581	123	485	9.99776	187	9.00805	125	0.99195	164	11
50	10164	9.00704	124	99482	9.99775	10216	9.00930	125	0.99070	9.7882	10
51	192	9.00828	123	479	9.99773	246	9.01055	124	0.98945	601	9
52	221	9.00951	123	476	9.99772	275	9.01179	124	0.98821	322	8
53	250	9.01074	122	473	9.99771	305	9.01303	124	0.98697	044	7
54	279	9.01196	122	470	9.99769	334	9.01427	123	0.98573	9.6768	6
55	10308	9.01318	122	99467	9.99768	10363	9.01550	123	0.98450	9.6493	5
56	337	9.01440	121	464	9.99767	393	9.01673	123	0.98327	220	4
57	366	9.01561	121	461	9.99765	422	9.01796	122	0.98204	9.5949	3
58	395	9.01682	121	458	9.99764	452	9.01918	122	0.98082	679	2
59	424	9.01803	120	455	9.99763	481	9.02040	122	0.97960	411	1
60	453	9.01923		452	9.99761	510	9.02162		0.97838	144	0
′	Nat. Cos	Log.	d.	Nat. Sin	Log.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	10453	9.01923	120	99452	9.99761	10510	9.02162	121	0.97838	9.5144	60
1	482	9.02043	120	449	9.99760	540	9.02283	121	0.97717	9.4878	59
2	511	9.02163	120	446	9.99759	569	9.02404	121	0.97596	614	58
3	540	9.02283	119	443	9.99757	599	9.02525	120	0.97475	352	57
4	569	9.02402	118	440	9.99756	628	9.02645	121	0.97355	090	56
5	10597	9.02520	119	99437	9.99755	10657	9.02766	119	0.97234	9.3831	55
6	626	9.02639	118	434	9.99753	687	9.02885	120	0.97115	572	54
7	655	9.02757	117	431	9.99752	716	9.03005	119	0.96995	315	53
8	684	9.02874	118	428	9.99751	746	9.03124	118	0.96876	060	52
9	713	9.02992	117	424	9.99749	775	9.03242	119	0.96758	9.2806	51
10	10742	9.03109	117	99421	9.99748	10805	9.03361	118	0.96639	9.2553	50
11	771	9.03226	116	418	9.99747	834	9.03479	118	0.96521	302	49
12	800	9.03342	116	415	9.99745	863	9.03597	117	0.96403	052	48
13	829	9.03458	116	412	9.99744	893	9.03714	118	0.96286	9.1803	47
14	858	9.03574	116	409	9.99742	922	9.03832	116	0.96168	555	46
15	10887	9.03690	115	99406	9.99741	10952	9.03948	117	0.96052	9.1309	45
16	916	9.03805	115	402	9.99740	981	9.04065	116	0.95935	065	44
17	945	9.03920	114	399	9.99738	11011	9.04181	116	0.95819	9.0821	43
18	973	9.04034	115	396	9.99737	040	9.04297	116	0.95703	579	42
19	11002	9.04149	113	393	9.99736	070	9.04413	115	0.95587	338	41
20	11031	9.04262	114	99390	9.99734	11099	9.04528	115	0.95472	9.0098	40
21	060	9.04376	114	386	9.99733	128	9.04643	115	0.95357	8.9860	39
22	089	9.04490	113	383	9.99731	158	9.04758	115	0.95242	623	38
23	118	9.04603	112	380	9.99730	187	9.04873	114	0.95127	387	37
24	147	9.04715	113	377	9.99728	217	9.04987	114	0.95013	152	36
25	11176	9.04828	112	99374	9.99727	11246	9.05101	113	0.94899	8.8919	35
26	205	9.04940	112	370	9.99726	276	9.05214	114	0.94786	686	34
27	234	9.05052	112	367	9.99724	305	9.05328	113	0.94672	455	33
28	263	9.05164	111	364	9.99723	335	9.05441	112	0.94559	225	32
29	291	9.05275	111	360	9.99721	364	9.05553	113	0.94447	8.7996	31
30	11320	9.05386	111	99357	9.99720	11394	9.05666	112	0.94334	8.7769	30
31	349	9.05497	110	354	9.99718	423	9.05778	112	0.94222	542	29
32	378	9.05607	110	351	9.99717	452	9.05890	112	0.94110	317	28
33	407	9.05717	110	347	9.99716	482	9.06002	111	0.93998	093	27
34	436	9.05827	110	344	9.99714	511	9.06113	111	0.93887	8.6870	26
35	11465	9.05937	109	99341	9.99713	11541	9.06224	111	0.93776	8.6648	25
36	494	9.06046	109	337	9.99711	570	9.06335	110	0.93665	427	24
37	523	9.06155	109	334	9.99710	600	9.06445	111	0.93555	208	23
38	552	9.06264	108	331	9.99708	629	9.06556	110	0.93444	8.5989	22
39	580	9.06372	109	327	9.99707	659	9.06666	109	0.93334	772	21
40	11609	9.06481	108	99324	9.99705	11688	9.06775	110	0.93225	8.5555	20
41	638	9.06589	107	320	9.99704	718	9.06885	109	0.93115	340	19
42	667	9.06696	108	317	9.99702	747	9.06994	109	0.93006	126	18
43	696	9.06804	107	314	9.99701	777	9.07103	108	0.92897	8.4913	17
44	725	9.06911	107	310	9.99699	806	9.07211	109	0.92789	701	16
45	11754	9.07018	106	99307	9.99698	11836	9.07320	108	0.92680	8.4490	15
46	783	9.07124	107	303	9.99696	865	9.07428	108	0.92572	280	14
47	812	9.07231	106	300	9.99695	895	9.07536	107	0.92464	071	13
48	840	9.07337	105	297	9.99693	924	9.07643	108	0.92357	8.3863	12
49	869	9.07442	106	293	9.99692	954	9.07751	107	0.92249	656	11
50	11898	9.07548	105	99290	9.99690	11983	9.07858	106	0.92142	8.3450	10
51	927	9.07653	105	286	9.99689	12013	9.07964	107	0.92036	245	9
52	956	9.07758	105	283	9.99687	042	9.08071	106	0.91929	041	8
53	985	9.07863	105	279	9.99686	072	9.08177	106	0.91823	8.2838	7
54	12014	9.07968	104	276	9.99684	101	9.08283	106	0.91717	636	6
55	12043	9.08072	104	99272	9.99683	12131	9.08389	106	0.91611	8.2434	5
56	071	9.08176	104	269	9.99681	160	9.08495	105	0.91505	234	4
57	100	9.08280	103	265	9.99680	190	9.08600	105	0.91400	035	3
58	129	9.08383	103	262	9.99678	219	9.08705	105	0.91295	8.1837	2
59	158	9.08486	103	258	9.99677	249	9.08810	104	0.91190	640	1
60	187	9.08589		255	9.99675	278	9.08914		0.91086	443	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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7°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	12187	9.08589	103	99255	9.99675	12278	9.08914	105	0.91086	8.1443	60
1	216	9.08692	103	251	9.99674	308	9.09019	104	0.90981	248	59
2	245	9.08795	102	248	9.99672	338	9.09123	104	0.90877	054	58
3	274	9.08897	102	244	9.99670	367	9.09227	103	0.90773	8.0860	57
4	302	9.08999	102	240	9.99669	397	9.09330	104	0.90670	667	56
5	12331	9.09101	101	99237	9.99667	12426	9.09434	103	0.90566	8.0476	55
6	360	9.09202	102	233	9.99666	456	9.09537	103	0.90463	285	54
7	389	9.09304	101	230	9.99664	485	9.09640	103	0.90360	095	53
8	418	9.09405	101	226	9.99663	515	9.09742	102	0.90258	7.9906	52
9	447	9.09506	100	222	9.99661	544	9.09845	103	0.90155	718	51
10	12476	9.09606	101	99219	9.99659	12574	9.09947	102	0.90053	7.9530	50
11	504	9.09707	100	215	9.99658	603	9.10049	101	0.89951	344	49
12	533	9.09807	100	211	9.99656	633	9.10150	102	0.89850	158	48
13	562	9.09907	99	208	9.99655	662	9.10252	101	0.89748	7.8973	47
14	591	9.10006	100	204	9.99653	692	9.10353	101	0.89647	789	46
15	12620	9.10106	99	99200	9.99651	12722	9.10454	101	0.89546	7.8606	45
16	649	9.10205	99	197	9.99650	751	9.10555	101	0.89445	424	44
17	678	9.10304	98	193	9.99648	781	9.10656	100	0.89344	243	43
18	706	9.10402	99	189	9.99647	810	9.10756	100	0.89244	062	42
19	735	9.10501	98	186	9.99645	840	9.10856	100	0.89144	7.7882	41
20	12764	9.10599	98	99182	9.99643	12869	9.10956	100	0.89044	7.7704	40
21	793	9.10697	98	178	9.99642	899	9.11056	99	0.88944	525	39
22	822	9.10795	98	175	9.99640	929	9.11155	99	0.88845	348	38
23	851	9.10893	97	171	9.99638	958	9.11254	99	0.88746	171	37
24	880	9.10990	97	167	9.99637	988	9.11353	99	0.88647	7.6996	36
25	12908	9.11087	97	99163	9.99635	13017	9.11452	99	0.88548	7.6821	35
26	937	9.11184	97	160	9.99633	047	9.11551	98	0.88449	647	34
27	966	9.11281	96	156	9.99632	076	9.11649	98	0.88351	473	33
28	995	9.11377	97	152	9.99630	106	9.11747	98	0.88253	301	32
29	13024	9.11474	96	148	9.99629	136	9.11845	98	0.88155	129	31
30	13053	9.11570	96	99144	9.99627	13165	9.11943	97	0.88057	7.5958	30
31	081	9.11666	95	141	9.99625	195	9.12040	98	0.87960	787	29
32	110	9.11761	96	137	9.99624	224	9.12138	97	0.87862	618	28
33	139	9.11857	95	133	9.99622	254	9.12235	97	0.87765	449	27
34	168	9.11952	95	129	9.99620	284	9.12332	96	0.87668	281	26
35	13197	9.12047	95	99125	9.99618	13313	9.12428	97	0.87572	7.5113	25
36	226	9.12142	94	122	9.99617	343	9.12525	96	0.87475	7.4947	24
37	254	9.12236	95	118	9.99615	372	9.12621	96	0.87379	781	23
38	283	9.12331	94	114	9.99613	402	9.12717	96	0.87283	615	22
39	312	9.12425	94	110	9.99612	432	9.12813	96	0.87187	451	21
40	13341	9.12519	93	99106	9.99610	13461	9.12909	95	0.87091	7.4287	20
41	370	9.12612	94	102	9.99608	491	9.13004	95	0.86996	124	19
42	399	9.12706	93	098	9.99607	521	9.13099	95	0.86901	7.3962	18
43	427	9.12799	93	094	9.99605	550	9.13194	95	0.86806	800	17
44	456	9.12892	93	091	9.99603	580	9.13289	95	0.86711	639	16
45	13485	9.12985	93	99087	9.99601	13609	9.13384	94	0.86616	7.3479	15
46	514	9.13078	93	083	9.99600	639	9.13478	95	0.86522	319	14
47	543	9.13171	92	079	9.99598	669	9.13573	94	0.86427	160	13
48	572	9.13263	92	075	9.99596	698	9.13667	94	0.86333	002	12
49	600	9.13355	92	071	9.99595	728	9.13761	94	0.86239	7.2844	11
50	13629	9.13447	92	99067	9.99593	13758	9.13854	93	0.86146	7.2687	10
51	658	9.13539	91	063	9.99591	787	9.13948	94	0.86052	531	9
52	687	9.13630	92	059	9.99589	817	9.14041	93	0.85959	375	8
53	716	9.13722	91	055	9.99588	846	9.14134	93	0.85866	220	7
54	744	9.13813	91	051	9.99586	876	9.14227	93	0.85773	066	6
55	13773	9.13904	90	99047	9.99584	13906	9.14320	92	0.85680	7.1912	5
56	802	9.13994	91	043	9.99582	935	9.14412	92	0.85588	759	4
57	831	9.14085	90	039	9.99581	965	9.14504	93	0.85496	607	3
58	860	9.14175	91	035	9.99579	995	9.14597	91	0.85403	455	2
59	889	9.14266	90	031	9.99577	14024	9.14688	92	0.85312	304	1
60	917	9.14356	90	027	9.99575	054	9.14780	92	0.85220	154	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	13917	9.14356		99027	9.99575	14054	9.14780		0.85220	7.1154	60
1	946	9.14445	89	023	9.99574	084	9.14872	92	0.85128	004	59
2	975	9.14535	90	019	9.99572	113	9.14963	91	0.85037	7.0855	58
3	14004	9.14624	89	015	9.99570	143	9.15054	91	0.84946	706	57
4	033	9.14714	90	011	9.99568	173	9.15145	91	0.84855	558	56
5	14061	9.14803	89	99006	9.99566	14202	9.15236	91	0.84764	7.0410	55
6	090	9.14891	88	002	9.99565	232	9.15327	91	0.84673	264	54
7	119	9.14980	89	98998	9.99563	262	9.15417	90	0.84583	117	53
8	148	9.15069	89	994	9.99561	291	9.15508	91	0.84492	6.9972	52
9	177	9.15157	88	990	9.99559	321	9.15598	90	0.84402	827	51
10	14205	9.15245	88	98986	9.99557	14351	9.15688	90	0.84312	6.9682	50
11	234	9.15333	88	982	9.99556	381	9.15777	89	0.84223	538	49
12	263	9.15421	88	978	9.99554	410	9.15867	90	0.84133	395	48
13	292	9.15508	87	973	9.99552	440	9.15956	89	0.84044	252	47
14	320	9.15596	88	969	9.99550	470	9.16046	90	0.83954	110	46
15	14349	9.15683	87	98965	9.99548	14499	9.16135	89	0.83865	6.8969	45
16	378	9.15770	87	961	9.99546	529	9.16224	89	0.83776	828	44
17	407	9.15857	87	957	9.99545	559	9.16312	88	0.83688	687	43
18	436	9.15944	86	953	9.99543	588	9.16401	89	0.83599	548	42
19	464	9.16030	86	948	9.99541	618	9.16489	88	0.83511	408	41
20	14493	9.16116	87	98944	9.99539	14648	9.16577	88	0.83423	6.8269	40
21	522	9.16203	86	940	9.99537	678	9.16665	88	0.83335	131	39
22	551	9.16289	85	936	9.99535	707	9.16753	88	0.83247	6.7994	38
23	580	9.16374	86	931	9.99533	737	9.16841	87	0.83159	856	37
24	608	9.16460	85	927	9.99532	767	9.16928	88	0.83072	720	36
25	14637	9.16545	86	98923	9.99530	14796	9.17016	87	0.82984	6.7584	35
26	666	9.16631	85	919	9.99528	826	9.17103	87	0.82897	448	34
27	695	9.16716	85	914	9.99526	856	9.17190	87	0.82810	313	33
28	723	9.16801	85	910	9.99524	886	9.17277	86	0.82723	179	32
29	752	9.16886	84	906	9.99522	915	9.17363	87	0.82637	045	31
30	14781	9.16970	85	98902	9.99520	14945	9.17450	86	0.82550	6.6912	30
31	810	9.17055	84	897	9.99518	975	9.17536	86	0.82464	779	29
32	838	9.17139	84	893	9.99517	15005	9.17622	86	0.82378	646	28
33	867	9.17223	84	889	9.99515	034	9.17708	86	0.82292	514	27
34	896	9.17307	84	884	9.99513	064	9.17794	86	0.82206	383	26
35	14925	9.17391	83	98880	9.99511	15094	9.17880	85	0.82120	6.6252	25
36	954	9.17474	84	876	9.99509	124	9.17965	86	0.82035	122	24
37	982	9.17558	83	871	9.99507	153	9.18051	85	0.81949	6.5992	23
38	15011	9.17641	83	867	9.99505	183	9.18136	85	0.81864	863	22
39	040	9.17724	83	863	9.99503	213	9.18221	85	0.81779	734	21
40	15069	9.17807	83	98858	9.99501	15243	9.18306	85	0.81694	6.5606	20
41	097	9.17890	83	854	9.99499	272	9.18391	84	0.81609	478	19
42	126	9.17973	82	849	9.99497	302	9.18475	85	0.81525	350	18
43	155	9.18055	82	845	9.99495	332	9.18560	84	0.81440	223	17
44	184	9.18137	83	841	9.99494	362	9.18644	84	0.81356	097	16
45	15212	9.18220	82	98836	9.99492	15391	9.18728	84	0.81272	6.4971	15
46	241	9.18302	81	832	9.99490	421	9.18812	84	0.81188	846	14
47	270	9.18383	82	827	9.99488	451	9.18896	83	0.81104	721	13
48	299	9.18465	82	823	9.99486	481	9.18979	84	0.81021	596	12
49	327	9.18547	81	818	9.99484	511	9.19063	83	0.80937	472	11
50	15356	9.18628	81	98814	9.99482	15540	9.19146	83	0.80854	6.4348	10
51	385	9.18709	81	809	9.99480	570	9.19229	83	0.80771	225	9
52	414	9.18790	81	805	9.99478	600	9.19312	83	0.80688	103	8
53	442	9.18871	81	800	9.99476	630	9.19395	83	0.80605	6.3980	7
54	471	9.18952	81	796	9.99474	660	9.19478	83	0.80522	859	6
55	15500	9.19033	80	98791	9.99472	15689	9.19561	82	0.80439	6.3737	5
56	529	9.19113	80	787	9.99470	719	9.19643	82	0.80357	617	4
57	557	9.19193	80	782	9.99468	749	9.19725	82	0.80275	496	3
58	586	9.19273	80	778	9.99466	779	9.19807	82	0.80193	376	2
59	615	9.19353	80	773	9.99464	809	9.19889	82	0.80111	257	1
60	643	9.19433	80	769	9.99462	838	9.19971	82	0.80029	138	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

9°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	15643	9.19433	80	98769	9.99462	15838	9.19971	82	0.80029	6.3138	60
1	672	9.19513	79	764	9.99460	868	9.20053	81	0.79947	019	59
2	701	9.19592	80	760	9.99458	898	9.20134	82	0.79866	6.2901	58
3	730	9.19672	79	755	9.99456	928	9.20216	81	0.79784	783	57
4	758	9.19751	79	751	9.99454	958	9.20297	81	0.79703	666	56
5	15787	9.19830	79	98746	9.99452	15988	9.20378	81	0.79622	6.2549	55
6	816	9.19909	79	741	9.99450	16017	9.20459	81	0.79541	432	54
7	845	9.19988	79	737	9.99448	047	9.20540	81	0.79460	316	53
8	873	9.20067	78	732	9.99446	077	9.20621	80	0.79379	200	52
9	902	9.20145	78	728	9.99444	107	9.20701	81	0.79299	085	51
10	15931	9.20223	78	98723	9.99442	16137	9.20782	81	0.79218	6.1970	50
11	959	9.20302	79	718	9.99440	167	9.20862	80	0.79138	856	49
12	988	9.20380	78	714	9.99438	196	9.20942	80	0.79058	742	48
13	16017	9.20458	78	709	9.99436	226	9.21022	80	0.78978	628	47
14	046	9.20535	77	704	9.99434	256	9.21102	80	0.78898	515	46
15	16074	9.20613	78	98700	9.99432	16286	9.21182	80	0.78818	6.1402	45
16	103	9.20691	77	695	9.99429	316	9.21261	79	0.78739	290	44
17	132	9.20768	77	690	9.99427	346	9.21341	80	0.78659	178	43
18	160	9.20845	77	686	9.99425	376	9.21420	79	0.78580	066	42
19	189	9.20922	77	681	9.99423	405	9.21499	79	0.78501	6.0955	41
20	16218	9.20999	77	98676	9.99421	16435	9.21578	79	0.78422	6.0844	40
21	246	9.21076	77	671	9.99419	465	9.21657	79	0.78343	734	39
22	275	9.21153	77	667	9.99417	495	9.21736	79	0.78264	624	38
23	304	9.21229	76	662	9.99415	525	9.21814	78	0.78186	514	37
24	333	9.21306	77	657	9.99413	555	9.21893	79	0.78107	405	36
25	16361	9.21382	76	98652	9.99411	16585	9.21971	78	0.78029	6.0296	35
26	390	9.21458	76	648	9.99409	615	9.22049	78	0.77951	188	34
27	419	9.21534	76	643	9.99407	645	9.22127	78	0.77873	080	33
28	447	9.21610	76	638	9.99404	674	9.22205	78	0.77795	5.9972	32
29	476	9.21685	75	633	9.99402	704	9.22283	78	0.77717	865	31
30	16505	9.21761	76	98629	9.99400	16734	9.22361	77	0.77639	5.9758	30
31	533	9.21836	75	624	9.99398	764	9.22438	78	0.77562	651	29
32	562	9.21912	76	619	9.99396	794	9.22516	77	0.77484	545	28
33	591	9.21987	75	614	9.99394	824	9.22593	77	0.77407	439	27
34	620	9.22062	75	609	9.99392	854	9.22670	77	0.77330	333	26
35	16648	9.22137	75	98604	9.99390	16884	9.22747	77	0.77253	5.9228	25
36	677	9.22211	74	600	9.99388	914	9.22824	77	0.77176	124	24
37	706	9.22286	75	595	9.99385	944	9.22901	77	0.77099	019	23
38	734	9.22361	75	590	9.99383	974	9.22977	76	0.77023	5.8915	22
39	763	9.22435	74	585	9.99381	17004	9.23054	77	0.76946	811	21
40	16792	9.22509	74	98580	9.99379	17033	9.23130	76	0.76870	5.8708	20
41	820	9.22583	74	575	9.99377	063	9.23206	76	0.76794	605	19
42	849	9.22657	74	570	9.99375	093	9.23283	77	0.76717	502	18
43	878	9.22731	74	565	9.99372	123	9.23359	76	0.76641	400	17
44	906	9.22805	74	561	9.99370	153	9.23435	76	0.76565	298	16
45	16935	9.22878	73	98556	9.99368	17183	9.23510	75	0.76490	5.8197	15
46	964	9.22952	74	551	9.99366	213	9.23586	76	0.76414	095	14
47	992	9.23025	73	546	9.99364	243	9.23661	75	0.76339	5.7994	13
48	17021	9.23098	73	541	9.99362	273	9.23737	76	0.76263	894	12
49	050	9.23171	73	536	9.99359	303	9.23812	75	0.76188	794	11
50	17078	9.23244	73	98531	9.99357	17333	9.23887	75	0.76113	5.7694	10
51	107	9.23317	73	526	9.99355	363	9.23962	75	0.76038	594	9
52	136	9.23390	73	521	9.99353	393	9.24037	75	0.75963	495	8
53	164	9.23462	72	516	9.99351	423	9.24112	75	0.75888	396	7
54	193	9.23535	73	511	9.99348	453	9.24186	74	0.75814	297	6
55	17222	9.23607	72	98506	9.99346	17483	9.24261	75	0.75739	5.7199	5
56	250	9.23679	72	501	9.99344	513	9.24335	74	0.75665	101	4
57	279	9.23752	73	496	9.99342	543	9.24410	75	0.75590	004	3
58	308	9.23823	71	491	9.99340	573	9.24484	74	0.75516	5.6906	2
59	336	9.23895	72	486	9.99337	603	9.24558	74	0.75442	809	1
60	365	9.23967	72	481	9.99335	633	9.24632	74	0.75368	713	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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10°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	17365	9.23967	72	98481	9.99335	2	17633	9.24632	74	0.75368	5.6713	60
1	393	9.24039	71	476	9.99333	2	663	9.24706	73	0.75294	617	59
2	422	9.24110	71	471	9.99331	3	693	9.24779	74	0.75221	521	58
3	451	9.24181	72	466	9.99328	2	723	9.24853	73	0.75147	425	57
4	479	9.24253	71	461	9.99326	2	753	9.24926	74	0.75074	329	56
5	17508	9.24324	71	98455	9.99324	2	17783	9.25000	73	0.75000	5.6234	55
6	537	9.24395	71	450	9.99322	3	813	9.25073	73	0.74927	140	54
7	565	9.24466	70	445	9.99319	2	843	9.25146	73	0.74854	045	53
8	594	9.24536	71	440	9.99317	2	873	9.25219	73	0.74781	5.5951	52
9	623	9.24607	70	435	9.99315	2	903	9.25292	73	0.74708	857	51
10	17651	9.24677	71	98430	9.99313	3	17933	9.25365	72	0.74635	5.5764	50
11	680	9.24748	70	425	9.99310	2	963	9.25437	73	0.74563	671	49
12	708	9.24818	70	420	9.99308	2	993	9.25510	72	0.74490	578	48
13	737	9.24888	70	414	9.99306	2	18023	9.25582	73	0.74418	485	47
14	766	9.24958	70	409	9.99304	3	053	9.25655	72	0.74345	393	46
15	17794	9.25028	70	98404	9.99301	2	18083	9.25727	72	0.74273	5.5301	45
16	823	9.25098	70	399	9.99299	2	113	9.25799	72	0.74201	209	44
17	852	9.25168	69	394	9.99297	3	143	9.25871	72	0.74129	118	43
18	880	9.25237	70	389	9.99294	2	173	9.25943	72	0.74057	026	42
19	909	9.25307	69	383	9.99292	2	203	9.26015	71	0.73985	5.4936	41
20	17937	9.25376	69	98378	9.99290	2	18233	9.26086	72	0.73914	5.4845	40
21	966	9.25445	69	373	9.99288	3	263	9.26158	71	0.73842	755	39
22	995	9.25514	69	368	9.99285	2	293	9.26229	72	0.73771	665	38
23	18023	9.25583	69	362	9.99283	2	323	9.26301	71	0.73699	575	37
24	052	9.25652	69	357	9.99281	3	353	9.26372	71	0.73628	486	36
25	18081	9.25721	69	98352	9.99278	2	18384	9.26443	71	0.73557	5.4397	35
26	109	9.25790	68	347	9.99276	2	414	9.26514	71	0.73486	308	34
27	138	9.25858	69	341	9.99274	3	444	9.26585	70	0.73415	219	33
28	166	9.25927	68	336	9.99271	2	474	9.26655	71	0.73345	131	32
29	195	9.25995	68	331	9.99269	2	504	9.26726	71	0.73274	043	31
30	18224	9.26063	68	98325	9.99267	3	18534	9.26797	70	0.73203	5.3955	30
31	252	9.26131	68	320	9.99264	2	564	9.26867	70	0.73133	868	29
32	281	9.26199	68	315	9.99262	2	594	9.26937	71	0.73063	781	28
33	309	9.26267	68	310	9.99260	3	624	9.27008	70	0.72992	694	27
34	338	9.26335	68	304	9.99257	2	654	9.27078	70	0.72922	607	26
35	18367	9.26403	67	98299	9.99255	3	18684	9.27148	70	0.72852	5.3521	25
36	395	9.26470	68	294	9.99252	2	714	9.27218	70	0.72782	435	24
37	424	9.26538	67	288	9.99250	2	745	9.27288	69	0.72712	349	23
38	452	9.26605	67	283	9.99248	3	775	9.27357	70	0.72643	263	22
39	481	9.26672	67	277	9.99245	2	805	9.27427	69	0.72573	178	21
40	18509	9.26739	67	98272	9.99243	2	18835	9.27496	70	0.72504	5.3093	20
41	538	9.26806	67	267	9.99241	3	865	9.27566	69	0.72434	008	19
42	567	9.26873	67	261	9.99238	2	895	9.27635	69	0.72365	5.2924	18
43	595	9.26940	67	256	9.99236	3	925	9.27704	69	0.72296	839	17
44	624	9.27007	66	250	9.99233	2	955	9.27773	69	0.72227	755	16
45	18652	9.27073	67	98245	9.99231	2	18986	9.27842	69	0.72158	5.2672	15
46	681	9.27140	66	240	9.99229	3	19016	9.27911	69	0.72089	588	14
47	710	9.27206	67	234	9.99226	2	046	9.27980	69	0.72020	505	13
48	738	9.27273	66	229	9.99224	3	076	9.28049	68	0.71951	422	12
49	767	9.27339	66	223	9.99221	2	106	9.28117	69	0.71883	339	11
50	18795	9.27405	66	98218	9.99219	2	19136	9.28186	68	0.71814	5.2257	10
51	824	9.27471	66	212	9.99217	3	166	9.28254	69	0.71746	174	9
52	852	9.27537	65	207	9.99214	2	197	9.28323	68	0.71677	092	8
53	881	9.27602	66	201	9.99212	3	227	9.28391	68	0.71609	011	7
54	910	9.27668	66	196	9.99209	2	257	9.28459	68	0.71541	5.1929	6
55	18938	9.27734	65	98190	9.99207	3	19287	9.28527	68	9.71473	5.1848	5
56	967	9.27799	65	185	9.99204	2	317	9.28595	67	0.71405	767	4
57	995	9.27864	66	179	9.99202	3	347	9.28662	68	0.71338	686	3
58	19024	9.27930	65	174	9.99200	2	378	9.28730	68	0.71270	606	2
59	052	9.27995	65	168	9.99197	3	408	9.28798	67	0.71202	526	1
60	081	9.28060	65	163	9.99195	2	438	9.28865	67	0.71135	446	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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11°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	19081	9.28060	65	98163	9.99195	3	19438	9.28865	68	0.71135	5.1446	60
1	109	9.28125	65	157	9.99192	2	468	9.28933	67	0.71067	366	59
2	138	9.28190	64	152	9.99190	3	498	9.29000	67	0.71000	286	58
3	167	9.28254	65	146	9.99187	2	529	9.29067	67	0.70933	207	57
4	195	9.28319	65	140	9.99185	3	559	9.29134	67	0.70866	128	56
5	19224	9.28384	64	98135	9.99182	2	19589	9.29201	67	0.70799	5.1049	55
6	252	9.28448	64	129	9.99180	3	619	9.29268	67	0.70732	5.0970	54
7	281	9.28512	65	124	9.99177	2	649	9.29335	67	0.70665	892	53
8	309	9.28577	64	118	9.99175	3	680	9.29402	66	0.70598	814	52
9	338	9.28641	64	112	9.99172	2	710	9.29468	67	0.70532	736	51
10	19366	9.28705	64	98107	9.99170	3	19740	9.29535	66	0.70465	5.0658	50
11	395	9.28769	64	101	9.99167	2	770	9.29601	67	0.70399	581	49
12	423	9.28833	63	096	9.99165	3	801	9.29668	66	0.70332	504	48
13	452	9.28896	64	090	9.99162	2	831	9.29734	66	0.70266	427	47
14	481	9.28960	64	084	9.99160	3	861	9.29800	66	0.70200	350	46
15	19509	9.29024	63	98079	9.99157	2	19891	9.29866	66	0.70134	5.0273	45
16	538	9.29087	63	073	9.99155	3	921	9.29932	66	0.70068	197	44
17	566	9.29150	64	067	9.99152	2	952	9.29998	66	0.70002	121	43
18	595	9.29214	63	061	9.99150	3	982	9.30064	66	0.69936	045	42
19	623	9.29277	63	056	9.99147	2	20012	9.30130	65	0.69870	4.9969	41
20	19652	9.29340	63	98050	9.99145	3	20042	9.30195	66	0.69805	4.9894	40
21	680	9.29403	63	044	9.99142	2	073	9.30261	65	0.69739	819	39
22	709	9.29466	63	039	9.99140	3	103	9.30326	65	0.69674	744	38
23	737	9.29529	62	033	9.99137	2	133	9.30391	66	0.69609	669	37
24	766	9.29591	63	027	9.99135	3	164	9.30457	65	0.69543	594	36
25	19794	9.29654	62	98021	9.99132	2	20194	9.30522	65	0.69478	4.9520	35
26	823	9.29716	63	016	9.99130	3	224	9.30587	65	0.69413	446	34
27	851	9.29779	62	010	9.99127	3	254	9.30652	65	0.69348	372	33
28	880	9.29841	62	004	9.99124	3	285	9.30717	65	0.69283	298	32
29	908	9.29903	63	97998	9.99122	2	315	9.30782	64	0.69218	225	31
30	19937	9.29966	62	97992	9.99119	3	20345	9.30846	65	0.69154	4.9152	30
31	965	9.30028	62	987	9.99117	2	376	9.30911	64	0.69089	078	29
32	994	9.30090	61	981	9.99114	3	406	9.30975	65	0.69025	006	28
33	20022	9.30151	62	975	9.99112	2	436	9.31040	64	0.68960	4.8933	27
34	051	9.30213	62	969	9.99109	3	466	9.31104	64	0.68896	860	26
35	20079	9.30275	61	97963	9.99106	3	20497	9.31168	65	0.68832	4.8788	25
36	108	9.30336	62	958	9.99104	2	527	9.31233	64	0.68767	716	24
37	136	9.30398	61	952	9.99101	3	557	9.31297	64	0.68703	644	23
38	165	9.30459	62	946	9.99099	2	588	9.31361	64	0.68639	573	22
39	193	9.30521	61	940	9.99096	3	618	9.31425	64	0.68575	501	21
40	20222	9.30582	61	97934	9.99093	3	20648	9.31489	63	0.68511	4.8430	20
41	250	9.30643	61	928	9.99091	2	679	9.31552	64	0.68448	359	19
42	279	9.30704	61	922	9.99088	3	709	9.31616	63	0.68384	288	18
43	307	9.30765	61	916	9.99086	2	739	9.31679	64	0.68321	218	17
44	336	9.30826	61	910	9.99083	3	770	9.31743	63	0.68257	147	16
45	20364	9.30887	60	97905	9.99080	3	20800	9.31806	64	0.68194	4.8077	15
46	393	9.30947	61	899	9.99078	2	830	9.31870	63	0.68130	007	14
47	421	9.31008	60	893	9.99075	3	861	9.31933	63	0.68067	4.7937	13
48	450	9.31068	61	887	9.99072	3	891	9.31996	63	0.68004	867	12
49	478	9.31129	60	881	9.99070	2	921	9.32059	63	0.67941	798	11
50	20507	9.31189	61	97875	9.99067	3	20952	9.32122	63	0.67878	4.7729	10
51	535	9.31250	60	869	9.99064	3	982	9.32185	63	0.67815	659	9
52	563	9.31310	60	863	9.99062	2	21013	9.32248	63	0.67752	591	8
53	592	9.31370	60	857	9.99059	3	043	9.32311	63	0.67689	522	7
54	620	9.31430	60	851	9.99056	3	073	9.32373	62	0.67627	453	6
55	20649	9.31490	59	97845	9.99054	2	21104	9.32436	63	0.67564	4.7385	5
56	677	9.31549	60	839	9.99051	3	134	9.32498	62	0.67502	317	4
57	706	9.31609	60	833	9.99048	3	164	9.32561	63	0.67439	249	3
58	734	9.31669	59	827	9.99046	2	195	9.32623	62	0.67377	181	2
59	763	9.31728	60	821	9.99043	3	225	9.32685	62	0.67315	114	1
60	791	9.31788		815	9.99040	3	256	9.32747		0.67253	046	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	20791	9.31788		97815	9.99040		21256	9.32747		0.67253	4.7046	60
1	820	9.31847	59	809	9.99038	2	286	9.32810	63	0.67190	4.6979	59
2	848	9.31907	60	803	9.99035	3	316	9.32872	62	0.67128	912	58
3	877	9.31966	59	797	9.99032	3	347	9.32933	61	0.67067	845	57
4	905	9.32025	59	791	9.99030	2	377	9.32995	62	0.67005	779	56
5	20933	9.32084	59	97784	9.99027	3	21408	9.33057	62	0.66943	4.6712	55
6	962	9.32143	59	778	9.99024	3	438	9.33119	61	0.66881	646	54
7	990	9.32202	59	772	9.99022	2	469	9.33180	62	0.66820	580	53
8	21019	9.32261	59	766	9.99019	3	499	9.33242	61	0.66758	514	52
9	047	9.32319	58	760	9.99016	3	529	9.33303	62	0.66697	448	51
10	21076	9.32378	59	97754	9.99013	3	21560	9.33365	61	0.66635	4.6382	50
11	104	9.32437	59	748	9.99011	2	590	9.33426	61	0.66574	317	49
12	132	9.32495	58	742	9.99008	3	621	9.33487	61	0.66513	252	48
13	161	9.32553	58	735	9.99005	3	651	9.33548	61	0.66452	187	47
14	189	9.32612	59	729	9.99002	3	682	9.33609	61	0.66391	122	46
15	21218	9.32670	58	97723	9.99000	2	21712	9.33670	61	0.66330	4.6057	45
16	246	9.32728	58	717	9.98997	3	743	9.33731	61	0.66269	4.5993	44
17	275	9.32786	58	711	9.98994	3	773	9.33792	61	0.66208	928	43
18	303	9.32844	58	705	9.98991	3	804	9.33853	60	0.66147	864	42
19	331	9.32902	58	698	9.98989	2	834	9.33913	61	0.66087	800	41
20	21360	9.32960	58	97692	9.98986	3	21864	9.33974	60	0.66026	4.5736	40
21	388	9.33018	57	686	9.98983	3	895	9.34034	61	0.65966	673	39
22	417	9.33075	58	680	9.98980	3	925	9.34095	60	0.65905	609	38
23	445	9.33133	57	673	9.98978	2	956	9.34155	60	0.65845	546	37
24	474	9.33190	58	667	9.98975	3	986	9.34215	60	0.65785	483	36
25	21502	9.33248	57	97661	9.98972	3	22017	9.34276	61	0.65724	4.5420	35
26	530	9.33305	57	655	9.98969	3	047	9.34336	60	0.65664	357	34
27	559	9.33362	57	648	9.98967	2	078	9.34396	60	0.65604	294	33
28	587	9.33420	58	642	9.98964	3	108	9.34456	60	0.65544	232	32
29	616	9.33477	57	636	9.98961	3	139	9.34516	60	0.65484	169	31
30	21644	9.33534	57	97630	9.98958	3	22169	9.34576	60	0.65424	4.5107	30
31	672	9.33591	57	623	9.98955	3	200	9.34635	59	0.65365	045	29
32	701	9.33647	56	617	9.98953	2	231	9.34695	60	0.65305	4.4983	28
33	729	9.33704	57	611	9.98950	3	261	9.34755	60	0.65245	922	27
34	758	9.33761	57	604	9.98947	3	292	9.34814	59	0.65186	860	26
35	21786	9.33818	57	97598	9.98944	3	22322	9.34874	60	0.65126	4.4799	25
36	814	9.33874	56	592	9.98941	3	353	9.34933	59	0.65067	737	24
37	843	9.33931	57	585	9.98938	3	383	9.34992	59	0.65008	676	23
38	871	9.33987	56	579	9.98936	2	414	9.35051	59	0.64949	615	22
39	899	9.34043	56	573	9.98933	3	444	9.35111	60	0.64889	555	21
40	21928	9.34100	57	97566	9.98930	3	22475	9.35170	59	0.64830	4.4494	20
41	956	9.34156	56	560	9.98927	3	505	9.35229	59	0.64771	434	19
42	985	9.34212	56	553	9.98924	3	536	9.35288	59	0.64712	373	18
43	22013	9.34268	56	547	9.98921	2	567	9.35347	59	0.64653	313	17
44	041	9.34324	56	541	9.98919	3	597	9.35405	58	0.64595	253	16
45	22070	9.34380	56	97534	9.98916	3	22628	9.35464	59	0.64536	4.4194	15
46	098	9.34436	55	528	9.98913	3	658	9.35523	58	0.64477	134	14
47	126	9.34491	56	521	9.98910	3	689	9.35581	59	0.64419	075	13
48	155	9.34547	55	515	9.98907	3	719	9.35640	58	0.64360	015	12
49	183	9.34602	56	508	9.98904	3	750	9.35698	59	0.64302	4.3956	11
50	22212	9.34658	55	97502	9.98901	3	22781	9.35757	58	0.64243	4.3897	10
51	240	9.34713	56	496	9.98898	3	811	9.35815	58	0.64185	838	9
52	268	9.34769	55	489	9.98896	2	842	9.35873	58	0.64127	779	8
53	297	9.34824	55	483	9.98893	3	872	9.35931	58	0.64069	721	7
54	325	9.34879	55	476	9.98890	3	903	9.35989	58	0.64011	662	6
55	22353	9.34934	55	97470	9.98887	3	22934	9.36047	58	0.63953	4.3604	5
56	382	9.34989	55	463	9.98884	3	964	9.36105	58	0.63895	546	4
57	410	9.35044	55	457	9.98881	3	995	9.36163	58	0.63837	488	3
58	438	9.35099	55	450	9.98878	3	23026	9.36221	58	0.63779	430	2
59	467	9.35154	55	444	9.98875	3	056	9.36279	58	0.63721	372	1
60	495	9.35209	55	437	9.98872	3	087	9.36336	57	0.63664	315	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

13°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	22495	9.35209	54	97437	9.98872	3	23087	9.36336	58	0.63664	4.3315	60
1	523	9.35263	55	430	9.98869	2	117	9.36394	58	0.63606	257	59
2	552	9.35318	55	424	9.98867	3	148	9.36452	57	0.63548	200	58
3	580	9.35373	54	417	9.98864	3	179	9.36509	57	0.63491	143	57
4	608	9.35427	54	411	9.98861	3	209	9.36566	58	0.63434	086	56
5	22637	9.35481	55	97404	9.98858	3	23240	9.36624	57	0.63376	4.3029	55
6	665	9.35536	54	398	9.98855	3	271	9.36681	57	0.63319	4.2972	54
7	693	9.35590	54	391	9.98852	3	301	9.36738	57	0.63262	916	53
8	722	9.35644	54	384	9.98849	3	332	9.36795	57	0.63205	859	52
9	750	9.35698	54	378	9.98846	3	363	9.36852	57	0.63148	803	51
10	22778	9.35752	54	97371	9.98843	3	23393	9.36909	57	0.63091	4.2747	50
11	807	9.35806	54	365	9.98840	3	424	9.36966	57	0.63034	691	49
12	835	9.35860	54	358	9.98837	3	455	9.37023	57	0.62977	635	48
13	863	9.35914	54	351	9.98834	3	485	9.37080	57	0.62920	580	47
14	892	9.35968	54	345	9.98831	3	516	9.37137	56	0.62863	524	46
15	22920	9.36022	53	97338	9.98828	3	23547	9.37193	57	0.62807	4.2468	45
16	948	9.36075	54	331	9.98825	3	578	9.37250	56	0.62750	413	44
17	977	9.36129	53	325	9.98822	3	608	9.37306	57	0.62694	358	43
18	23005	9.36182	54	318	9.98819	3	639	9.37363	56	0.62637	303	42
19	033	9.36236	53	311	9.98816	3	670	9.37419	57	0.62581	248	41
20	23062	9.36289	53	97304	9.98813	3	23700	9.37476	56	0.62524	4.2193	40
21	090	9.36342	53	298	9.98810	3	731	9.37532	56	0.62468	139	39
22	118	9.36395	53	291	9.98807	3	762	9.37588	56	0.62412	084	38
23	146	9.36449	54	284	9.98804	3	793	9.37644	56	0.62356	030	37
24	175	9.36502	53	278	9.98801	3	823	9.37700	56	0.62300	4.1976	36
25	23203	9.36555	53	97271	9.98798	3	23854	9.37756	56	0.62244	4.1922	35
26	231	9.36608	52	264	9.98795	3	885	9.37812	56	0.62188	868	34
27	260	9.36660	53	257	9.98792	3	916	9.37868	56	0.62132	814	33
28	288	9.36713	53	251	9.98789	3	946	9.37924	56	0.62076	760	32
29	316	9.36766	53	244	9.98786	3	977	9.37980	56	0.62020	706	31
30	23345	9.36819	52	97237	9.98783	3	24008	9.38035	55	0.61965	4.1653	30
31	373	9.36871	53	230	9.98780	3	039	9.38091	56	0.61909	600	29
32	401	9.36924	52	223	9.98777	3	069	9.38147	56	0.61853	547	28
33	429	9.36976	52	217	9.98774	3	100	9.38202	55	0.61798	493	27
34	458	9.37028	53	210	9.98771	3	131	9.38257	55	0.61743	441	26
35	23486	9.37081	52	97203	9.98768	3	24162	9.38313	56	0.61687	4.1388	25
36	514	9.37133	52	196	9.98765	3	193	9.38368	55	0.61632	335	24
37	542	9.37185	52	189	9.98762	3	223	9.38423	55	0.61577	282	23
38	571	9.37237	52	182	9.98759	3	254	9.38479	56	0.61521	230	22
39	599	9.37289	52	176	9.98756	3	285	9.38534	55	0.61466	178	21
40	23627	9.37341	52	97169	9.98753	3	24316	9.38589	55	0.61411	4.1126	20
41	656	9.37393	52	162	9.98750	4	347	9.38644	55	0.61356	074	19
42	684	9.37445	52	155	9.98746	3	377	9.38699	55	0.61301	022	18
43	712	9.37497	52	148	9.98743	3	408	9.38754	54	0.61246	4.0970	17
44	740	9.37549	51	141	9.98740	3	439	9.38808	55	0.61192	918	16
45	23769	9.37600	52	97134	9.98737	3	24470	9.38863	55	0.61137	4.0867	15
46	797	9.37652	51	127	9.98734	3	501	9.38918	54	0.61082	815	14
47	825	9.37703	52	120	9.98731	3	532	9.38972	55	0.61028	764	13
48	853	9.37755	51	113	9.98728	3	562	9.39027	55	0.60973	713	12
49	882	9.37806	52	106	9.98725	3	593	9.39082	55	0.60918	662	11
50	23910	9.37858	51	97100	9.98722	3	24624	9.39136	54	0.60864	4.0611	10
51	938	9.37909	51	093	9.98719	4	655	9.39190	54	0.60810	560	9
52	966	9.37960	51	086	9.98715	3	686	9.39245	55	0.60755	509	8
53	995	9.38011	51	079	9.98712	3	717	9.39299	54	0.60701	459	7
54	24023	9.38062	51	072	9.98709	3	747	9.39353	54	0.60647	408	6
55	24051	9.38113	51	97065	9.98706	3	24778	9.39407	54	0.60593	4.0358	5
56	079	9.38164	51	058	9.98703	3	809	9.39461	54	0.60539	308	4
57	108	9.38215	51	051	9.98700	3	840	9.39515	54	0.60485	257	3
58	136	9.38266	51	044	9.98697	3	871	9.39569	54	0.60431	207	2
59	164	9.38317	51	037	9.98694	3	902	9.39623	54	0.60377	158	1
60	192	9.38368	51	030	9.98690	4	933	9.39677	54	0.60323	108	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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14°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	24192	9.38368	50	97030	9.98690	3	24933	9.39677	54	0.60323	4.0108	60
1	220	9.38418	51	023	9.98687	3	964	9.39731	54	0.60269	058	59
2	249	9.38469	50	015	9.98684	3	995	9.39785	54	0.60215	009	58
3	277	9.38519	51	008	9.98681	3	25026	9.39838	53	0.60162	3.9959	57
4	305	9.38570	50	001	9.98678	3	056	9.39892	54	0.60108	910	56
5	24333	9.38620	50	96994	9.98675	4	25087	9.39945	53	0.60055	3.9861	55
6	362	9.38670	51	987	9.98671	3	118	9.39999	54	0.60001	812	54
7	390	9.38721	50	980	9.98668	3	149	9.40052	53	0.59948	763	53
8	418	9.38771	50	973	9.98665	3	180	9.40106	54	0.59894	714	52
9	446	9.38821	50	966	9.98662	3	211	9.40159	53	0.59841	665	51
10	24474	9.38871	50	96959	9.98659	3	25242	9.40212	53	0.59788	3.9617	50
11	503	9.38921	50	952	9.98656	4	273	9.40266	54	0.59734	568	49
12	531	9.38971	50	945	9.98652	3	304	9.40319	53	0.59681	520	48
13	559	9.39021	50	937	9.98649	3	335	9.40372	53	0.59628	471	47
14	587	9.39071	50	930	9.98646	3	366	9.40425	53	0.59575	423	46
15	24615	9.39121	49	96923	9.98643	3	25397	9.40478	53	0.59522	3.9375	45
16	644	9.39170	50	916	9.98640	3	428	9.40531	53	0.59469	327	44
17	672	9.39220	50	909	9.98636	4	459	9.40584	53	0.59416	279	43
18	700	9.39270	49	902	9.98633	3	490	9.40636	52	0.59364	232	42
19	728	9.39319	50	894	9.98630	3	521	9.40689	53	0.59311	184	41
20	24756	9.39369	49	96887	9.98627	3	25552	9.40742	53	0.59258	3.9136	40
21	784	9.39418	49	880	9.98623	4	583	9.40795	53	0.59205	089	39
22	813	9.39467	50	873	9.98620	3	614	9.40847	52	0.59153	042	38
23	841	9.39517	49	866	9.98617	3	645	9.40900	53	0.59100	3.8995	37
24	869	9.39566	49	858	9.98614	3	676	9.40952	52	0.59048	947	36
25	24897	9.39615	49	96851	9.98610	4	25707	9.41005	53	0.58995	3.8900	35
26	925	9.39664	49	844	9.98607	3	738	9.41057	52	0.58943	854	34
27	954	9.39713	49	837	9.98604	3	769	9.41109	52	0.58891	807	33
28	982	9.39762	49	829	9.98601	3	800	9.41161	52	0.58839	760	32
29	25010	9.39811	49	822	9.98597	4	831	9.41214	53	0.58786	714	31
30	25038	9.39860	49	96815	9.98594	3	25862	9.41266	52	0.58734	3.8667	30
31	066	9.39909	49	807	9.98591	3	893	9.41318	52	0.58682	621	29
32	094	9.39958	48	800	9.98588	3	924	9.41370	52	0.58630	575	28
33	122	9.40006	49	793	9.98584	4	955	9.41422	52	0.58578	528	27
34	151	9.40055	48	786	9.98581	3	986	9.41474	52	0.58526	482	26
35	25179	9.40103	49	96778	9.98578	3	26017	9.41526	52	0.58474	3.8436	25
36	207	9.40152	48	771	9.98574	4	048	9.41578	52	0.58422	391	24
37	235	9.40200	49	764	9.98571	3	079	9.41629	51	0.58371	345	23
38	263	9.40249	48	756	9.98568	3	110	9.41681	52	0.58319	299	22
39	291	9.40297	49	749	9.98565	3	141	9.41733	52	0.58267	254	21
40	25320	9.40346	48	96742	9.98561	4	26172	9.41784	51	0.58216	3.8208	20
41	348	9.40394	48	734	9.98558	3	203	9.41836	52	0.58164	163	19
42	376	9.40442	48	727	9.98555	3	235	9.41887	51	0.58113	118	18
43	404	9.40490	48	719	9.98551	4	266	9.41939	52	0.58061	073	17
44	432	9.40538	48	712	9.98548	3	297	9.41990	51	0.58010	028	16
45	25460	9.40586	48	96705	9.98545	3	26328	9.42041	51	0.57959	3.7983	15
46	488	9.40634	48	697	9.98541	4	359	9.42093	52	0.57907	938	14
47	516	9.40682	48	690	9.98538	3	390	9.42144	51	0.57856	893	13
48	545	9.40730	48	682	9.98535	3	421	9.42195	51	0.57805	848	12
49	573	9.40778	47	675	9.98531	4	452	9.42246	51	0.57754	804	11
50	25601	9.40825	48	96667	9.98528	3	26483	9.42297	51	0.57703	3.7760	10
51	629	9.40873	48	660	9.98525	3	515	9.42348	51	0.57652	715	9
52	657	9.40921	47	653	9.98521	4	546	9.42399	51	0.57601	671	8
53	685	9.40968	48	645	9.98518	3	577	9.42450	51	0.57550	627	7
54	713	9.41016	47	638	9.98515	3	608	9.42501	51	0.57499	583	6
55	25741	9.41063	48	96630	9.98511	4	26639	9.42552	51	0.57448	3.7539	5
56	769	9.41111	47	623	9.98508	3	670	9.42603	51	0.57397	495	4
57	798	9.41158	47	615	9.98505	3	701	9.42653	50	0.57347	451	3
58	826	9.41205	47	608	9.98501	4	733	9.42704	51	0.57296	408	2
59	854	9.41252	47	600	9.98498	3	764	9.42755	51	0.57245	364	1
60	882	9.41300	48	593	9.98494	4	795	9.42805	50	0.57195	321	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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15°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	25882	9.41300	47	96593	9.98494	3	26795	9.42805	51	0.57195	3.7321	60
1	910	9.41347	47	585	9.98491	3	826	9.42850	50	0.57144	277	59
2	938	9.41394	47	578	9.98488	3	857	9.42900	51	0.57094	234	58
3	966	9.41441	47	570	9.98484	4	888	9.42957	50	0.57043	191	57
4	994	9.41488	47	562	9.98481	4	920	9.43007	50	0.56993	148	56
5	26022	9.41535	47	96555	9.98477	3	26951	9.43057	51	0.56943	3.7105	55
6	050	9.41582	46	547	9.98474	3	982	9.43108	50	0.56892	062	54
7	079	9.41628	47	540	9.98471	4	27013	9.43158	50	0.56842	019	53
8	107	9.41675	47	532	9.98467	3	044	9.43208	50	0.56792	3.6976	52
9	135	9.41722	46	524	9.98464	4	076	9.43258	50	0.56742	933	51
10	26163	9.41768	47	96517	9.98460	3	27107	9.43308	50	0.56692	3.6891	50
11	191	9.41815	46	509	9.98457	4	138	9.43358	50	0.56642	848	49
12	219	9.41861	47	502	9.98453	3	169	9.43408	50	0.56592	806	48
13	247	9.41908	46	494	9.98450	3	201	9.43458	50	0.56542	764	47
14	275	9.41954	47	486	9.98447	4	232	9.43508	50	0.56492	722	46
15	26303	9.42001	46	96479	9.98443	3	27263	9.43558	49	0.56442	3.6680	45
16	331	9.42047	46	471	9.98440	4	294	9.43607	50	0.56393	638	44
17	359	9.42093	47	463	9.98436	3	326	9.43657	50	0.56343	596	43
18	387	9.42140	46	456	9.98433	3	357	9.43707	49	0.56293	554	42
19	415	9.42186	46	448	9.98429	4	388	9.43756	50	0.56244	512	41
20	26443	9.42232	46	96440	9.98426	3	27419	9.43806	49	0.56194	3.6470	40
21	471	9.42278	46	433	9.98422	4	451	9.43855	50	0.56145	429	39
22	500	9.42324	46	425	9.98419	3	482	9.43905	49	0.56095	387	38
23	528	9.42370	46	417	9.98415	4	513	9.43954	50	0.56046	346	37
24	556	9.42416	46	410	9.98412	3	545	9.44004	49	0.55996	305	36
25	26584	9.42461	45	96402	9.98409	3	27576	9.44053	49	0.55947	3.6264	35
26	612	9.42507	46	394	9.98405	4	607	9.44102	49	0.55898	222	34
27	640	9.42553	46	386	9.98402	3	638	9.44151	49	0.55849	181	33
28	668	9.42599	46	379	9.98398	4	670	9.44201	50	0.55799	140	32
29	696	9.42644	45	371	9.98395	3	701	9.44250	49	0.55750	100	31
30	26724	9.42690	46	96363	9.98391	4	27732	9.44299	49	0.55701	3.6059	30
31	752	9.42735	45	355	9.98388	3	764	9.44348	49	0.55652	018	29
32	780	9.42781	46	347	9.98384	4	795	9.44397	49	0.55603	3.5978	28
33	808	9.42826	45	340	9.98381	3	826	9.44446	49	0.55554	937	27
34	836	9.42872	46	332	9.98377	4	858	9.44495	49	0.55505	897	26
35	26864	9.42917	45	96324	9.98373	4	27889	9.44544	49	0.55456	3.5856	25
36	892	9.42962	45	316	9.98370	3	921	9.44592	48	0.55408	816	24
37	920	9.43008	46	308	9.98366	4	952	9.44641	49	0.55359	776	23
38	948	9.43053	45	301	9.98363	3	983	9.44690	49	0.55310	736	22
39	976	9.43098	45	293	9.98359	4	28015	9.44738	48	0.55262	696	21
40	27004	9.43143	45	96285	9.98356	3	28046	9.44787	49	0.55213	3.5656	20
41	032	9.43188	45	277	9.98352	4	077	9.44836	49	0.55164	616	19
42	060	9.43233	45	269	9.98349	3	109	9.44884	48	0.55116	576	18
43	088	9.43278	45	261	9.98345	4	140	9.44933	49	0.55067	536	17
44	116	9.43323	45	253	9.98342	3	172	9.44981	48	0.55019	497	16
45	27144	9.43367	44	96246	9.98338	4	28203	9.45029	48	0.54971	3.5457	15
46	172	9.43412	45	238	9.98334	4	234	9.45078	49	0.54922	418	14
47	200	9.43457	45	230	9.98331	3	266	9.45126	48	0.54874	379	13
48	228	9.43502	45	222	9.98327	4	297	9.45174	48	0.54826	339	12
49	256	9.43546	44	214	9.98324	3	329	9.45222	48	0.54778	300	11
50	27284	9.43591	45	96206	9.98320	4	28360	9.45271	49	0.54729	3.5261	10
51	312	9.43635	44	198	9.98317	3	391	9.45319	48	0.54681	222	9
52	340	9.43680	45	190	9.98313	4	423	9.45367	48	0.54633	183	8
53	368	9.43724	44	182	9.98309	4	454	9.45415	48	0.54585	144	7
54	396	9.43769	45	174	9.98306	3	486	9.45463	48	0.54537	105	6
55	27424	9.43813	44	96166	9.98302	4	28517	9.45511	48	0.54489	3.5067	5
56	452	9.43857	44	158	9.98299	3	549	9.45559	47	0.54441	028	4
57	480	9.43901	44	150	9.98295	4	580	9.45606	48	0.54394	3.4989	3
58	508	9.43946	45	142	9.98291	4	612	9.45654	48	0.54346	951	2
59	536	9.43990	44	134	9.98288	3	643	9.45702	48	0.54298	912	1
60	564	9.44034	44	126	9.98284	4	675	9.45750	48	0.54250	874	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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16°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	27564	9.44034	44	96126	9.98284	3	28675	9.45750	47	0.54250	3.4874	60
1	592	9.44078	44	118	9.98281	4	706	9.45797	48	0.54203	836	59
2	620	9.44122	44	110	9.98277	4	738	9.45845	47	0.54155	798	58
3	648	9.44166	44	102	9.98273	3	769	9.45892	48	0.54108	760	57
4	676	9.44210	43	094	9.98270	4	801	9.45940	47	0.54060	722	56
5	27704	9.44253	44	96086	9.98266	4	28832	9.45987	48	0.54013	3.4684	55
6	731	9.44297	44	078	9.98262	3	864	9.46035	47	0.53965	646	54
7	759	9.44341	44	070	9.98259	4	895	9.46082	48	0.53918	608	53
8	787	9.44385	44	062	9.98255	4	927	9.46130	47	0.53870	570	52
9	815	9.44428	43	054	9.98251	4	958	9.46177	47	0.53823	533	51
10	27843	9.44472	44	96046	9.98248	3	28990	9.46224	47	0.53776	3.4495	50
11	871	9.44516	44	037	9.98244	4	29021	9.46271	48	0.53729	458	49
12	899	9.44559	43	029	9.98240	4	053	9.46319	47	0.53681	420	48
13	927	9.44602	43	021	9.98237	3	084	9.46366	47	0.53634	383	47
14	955	9.44646	44	013	9.98233	4	116	9.46413	47	0.53587	346	46
15	27983	9.44689	43	96005	9.98229	4	29147	9.46460	47	0.53540	3.4308	45
16	28011	9.44733	44	95997	9.98226	3	179	9.46507	47	0.53493	271	44
17	039	9.44776	43	989	9.98222	4	210	9.46554	47	0.53446	234	43
18	067	9.44819	43	981	9.98218	4	242	9.46601	47	0.53399	197	42
19	095	9.44862	43	972	9.98215	3	274	9.46648	47	0.53352	160	41
20	28123	9.44905	43	95964	9.98211	4	29305	9.46694	46	0.53306	3.4124	40
21	150	9.44948	43	956	9.98207	4	337	9.46741	47	0.53259	087	39
22	178	9.44992	44	948	9.98204	3	368	9.46788	47	0.53212	050	38
23	206	9.45035	43	940	9.98200	4	400	9.46835	47	0.53165	014	37
24	234	9.45077	42	931	9.98196	4	432	9.46881	46	0.53119	3.3977	36
25	28262	9.45120	43	95923	9.98192	4	29463	9.46928	47	0.53072	3.3941	35
26	290	9.45163	43	915	9.98189	3	495	9.46975	47	0.53025	904	34
27	318	9.45206	43	907	9.98185	4	526	9.47021	46	0.52979	868	33
28	346	9.45249	43	898	9.98181	4	558	9.47068	47	0.52932	832	32
29	374	9.45292	42	890	9.98177	4	590	9.47114	46	0.52886	796	31
30	28402	9.45334	43	95882	9.98174	3	29621	9.47160	46	0.52840	3.3759	30
31	429	9.45377	42	874	9.98170	4	653	9.47207	47	0.52793	723	29
32	457	9.45419	43	865	9.98166	4	685	9.47253	46	0.52747	687	28
33	485	9.45462	42	857	9.98162	4	716	9.47299	46	0.52701	652	27
34	513	9.45504	43	849	9.98159	3	748	9.47346	47	0.52654	616	26
35	28541	9.45547	42	95841	9.98155	4	29780	9.47392	46	0.52608	3.3580	25
36	569	9.45589	43	832	9.98151	4	811	9.47438	46	0.52562	544	24
37	597	9.45632	42	824	9.98147	4	843	9.47484	46	0.52516	509	23
38	625	9.45674	42	816	9.98144	3	875	9.47530	46	0.52470	473	22
39	652	9.45716	42	807	9.98140	4	906	9.47576	46	0.52424	438	21
40	28680	9.45758	43	95799	9.98136	4	29938	9.47622	46	0.52378	3.3402	20
41	708	9.45801	42	791	9.98132	3	970	9.47668	46	0.52332	367	19
42	736	9.45843	42	782	9.98129	4	30001	9.47714	46	0.52286	332	18
43	764	9.45885	42	774	9.98125	4	033	9.47760	46	0.52240	297	17
44	792	9.45927	42	766	9.98121	4	065	9.47806	46	0.52194	261	16
45	28820	9.45969	42	95757	9.98117	4	30097	9.47852	45	0.52148	3.3226	15
46	847	9.46011	42	749	9.98113	4	128	9.47897	46	0.52103	191	14
47	875	9.46053	42	740	9.98110	3	160	9.47943	46	0.52057	156	13
48	903	9.46095	41	732	9.98106	4	192	9.47989	46	0.52011	122	12
49	931	9.46136	42	724	9.98102	4	224	9.48035	45	0.51965	087	11
50	28959	9.46178	42	95715	9.98098	4	30255	9.48080	46	0.51920	3.3052	10
51	987	9.46220	42	707	9.98094	4	287	9.48126	45	0.51874	017	9
52	29015	9.46262	41	698	9.98090	3	319	9.48171	46	0.51829	3.2983	8
53	042	9.46303	42	690	9.98087	4	351	9.48217	45	0.51783	948	7
54	070	9.46345	41	681	9.98083	4	382	9.48262	45	0.51738	914	6
55	29098	9.46386	42	95673	9.98079	4	30414	9.48307	46	0.51693	3.2879	5
56	126	9.46428	41	664	9.98075	4	446	9.48353	45	0.51647	845	4
57	154	9.46469	42	656	9.98071	4	478	9.48398	45	0.51602	811	3
58	182	9.46511	41	647	9.98067	4	509	9.48443	46	0.51557	777	2
59	209	9.46552	42	639	9.98063	4	541	9.48489	45	0.51511	743	1
60	237	9.46594	42	630	9.98060	3	573	9.48534	45	0.51466	709	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	29237	9.46594	41	95630	9.98060	4	30573	9.48534	45	0.51466	3.2709	60
1	265	9.46635	41	622	9.98056	4	605	9.48579	45	0.51421	675	59
2	293	9.46676	41	613	9.98052	4	637	9.48624	45	0.51376	641	58
3	321	9.46717	41	605	9.98048	4	669	9.48669	45	0.51331	607	57
4	348	9.46758	42	596	9.98044	4	700	9.48714	45	0.51286	573	56
5	29376	9.46800	41	95588	9.98040	4	30732	9.48759	45	0.51241	3.2539	55
6	404	9.46841	41	579	9.98036	4	764	9.48804	45	0.51196	506	54
7	432	9.46882	41	571	9.98032	4	796	9.48849	45	0.51151	472	53
8	460	9.46923	41	562	9.98029	3	828	9.48894	45	0.51106	438	52
9	487	9.46964	41	554	9.98025	4	860	9.48939	45	0.51061	405	51
10	29515	9.47005	40	95545	9.98021	4	30891	9.48984	45	0.51016	3.2371	50
11	543	9.47045	41	536	9.98017	4	923	9.49029	44	0.50971	338	49
12	571	9.47086	41	528	9.98013	4	955	9.49073	45	0.50927	305	48
13	599	9.47127	41	519	9.98009	4	987	9.49118	45	0.50882	272	47
14	626	9.47168	41	511	9.98005	4	31019	9.49163	44	0.50837	238	46
15	29654	9.47209	40	95502	9.98001	4	31051	9.49207	45	0.50793	3.2205	45
16	682	9.47249	41	493	9.97997	4	083	9.49252	44	0.50748	172	44
17	710	9.47290	40	485	9.97993	4	115	9.49296	45	0.50704	139	43
18	737	9.47330	41	476	9.97989	3	147	9.49341	44	0.50659	106	42
19	765	9.47371	40	467	9.97986	4	178	9.49385	44	0.50615	073	41
20	29793	9.47411	41	95459	9.97982	4	31210	9.49430	45	0.50570	3.2041	40
21	821	9.47452	40	450	9.97978	4	242	9.49474	44	0.50526	008	39
22	849	9.47492	41	441	9.97974	4	274	9.49519	45	0.50481	3.1975	38
23	876	9.47533	40	433	9.97970	4	306	9.49563	44	0.50437	943	37
24	904	9.47573	40	424	9.97966	4	338	9.49607	44	0.50393	910	36
25	29932	9.47613	41	95415	9.97962	4	31370	9.49652	45	0.50348	3.1878	35
26	960	9.47654	40	407	9.97958	4	402	9.49696	44	0.50304	845	34
27	987	9.47694	40	398	9.97954	4	434	9.49740	44	0.50260	813	33
28	30015	9.47734	40	389	9.97950	4	466	9.49784	44	0.50216	780	32
29	043	9.47774	40	380	9.97946	4	498	9.49828	44	0.50172	748	31
30	30071	9.47814	40	95372	9.97942	4	31530	9.49872	44	0.50128	3.1716	30
31	098	9.47854	40	363	9.97938	4	562	9.49916	44	0.50084	684	29
32	126	9.47894	40	354	9.97934	4	594	9.49960	44	0.50040	652	28
33	154	9.47934	40	345	9.97930	4	626	9.50004	44	0.49996	620	27
34	182	9.47974	40	337	9.97926	4	658	9.50048	44	0.49952	588	26
35	30209	9.48014	40	95328	9.97922	4	31690	9.50092	44	0.49908	3.1556	25
36	237	9.48054	40	319	9.97918	4	722	9.50136	44	0.49864	524	24
37	265	9.48094	40	310	9.97914	4	754	9.50180	44	0.49820	492	23
38	292	9.48133	39	301	9.97910	4	786	9.50223	43	0.49777	460	22
39	320	9.48173	40	293	9.97906	4	818	9.50267	44	0.49733	429	21
40	30348	9.48213	40	95284	9.97902	4	31850	9.50311	44	0.49689	3.1397	20
41	376	9.48252	39	275	9.97898	4	882	9.50355	44	0.49645	366	19
42	403	9.48292	40	266	9.97894	4	914	9.50398	43	0.49602	334	18
43	431	9.48332	40	257	9.97890	4	946	9.50442	44	0.49558	303	17
44	459	9.48371	39	248	9.97886	4	978	9.50485	43	0.49515	271	16
45	30486	9.48411	40	95240	9.97882	4	32010	9.50529	44	0.49471	3.1240	15
46	514	9.48450	39	231	9.97878	4	042	9.50572	43	0.49428	209	14
47	542	9.48490	40	222	9.97874	4	074	9.50616	44	0.49384	178	13
48	570	9.48529	39	213	9.97870	4	106	9.50659	43	0.49341	146	12
49	597	9.48568	39	204	9.97866	4	139	9.50703	44	0.49297	115	11
50	30625	9.48607	39	95195	9.97861	5	32171	9.50746	43	0.49254	3.1084	10
51	653	9.48647	40	186	9.97857	4	203	9.50789	43	0.49211	053	9
52	680	9.48686	39	177	9.97853	4	235	9.50833	44	0.49167	022	8
53	708	9.48725	39	168	9.97849	4	267	9.50876	43	0.49124	3.0991	7
54	736	9.48764	39	159	9.97845	4	299	9.50919	43	0.49081	961	6
55	30763	9.48803	39	95150	9.97841	4	32331	9.50962	43	0.49038	3.0930	5
56	791	9.48842	39	142	9.97837	4	363	9.51005	43	0.48995	899	4
57	819	9.48881	39	133	9.97833	4	396	9.51048	43	0.48952	868	3
58	846	9.48920	39	124	9.97829	4	428	9.51092	44	0.48908	838	2
59	874	9.48959	39	115	9.97825	4	460	9.51135	43	0.48865	807	1
60	902	9.48998	39	106	9.97821	4	492	9.51178	43	0.48822	777	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	30902	9.48998	39	95106	9.97821	4	32492	9.51178	43	0.48822	3.0777	60
1	929	9.49037	39	097	9.97817	5	524	9.51221	43	0.48779	746	59
2	957	9.49076	39	088	9.97812	4	556	9.51264	42	0.48736	716	58
3	985	9.49115	38	079	9.97808	4	588	9.51306	43	0.48694	686	57
4	31012	9.49153	39	070	9.97804	4	621	9.51349	43	0.48651	655	56
5	31040	9.49192	39	95061	9.97800	4	32653	9.51392	43	0.48608	3.0625	55
6	068	9.49231	38	052	9.97796	4	685	9.51435	43	0.48565	595	54
7	095	9.49269	39	043	9.97792	4	717	9.51478	42	0.48522	565	53
8	123	9.49308	39	033	9.97788	4	749	9.51520	43	0.48480	535	52
9	151	9.49347	38	024	9.97784	4	782	9.51563	43	0.48437	505	51
10	31178	9.49385	39	95015	9.97779	5	32814	9.51606	42	0.48394	3.0475	50
11	206	9.49424	38	006	9.97775	4	846	9.51648	43	0.48352	445	49
12	233	9.49462	38	94997	9.97771	4	878	9.51691	43	0.48309	415	48
13	261	9.49500	39	988	9.97767	4	911	9.51734	42	0.48266	385	47
14	289	9.49539	38	979	9.97763	4	943	9.51776	43	0.48224	356	46
15	31316	9.49577	38	94970	9.97759	4	32975	9.51819	42	0.48181	3.0326	45
16	344	9.49615	39	961	9.97754	5	33007	9.51861	42	0.48139	296	44
17	372	9.49654	38	952	9.97750	4	040	9.51903	43	0.48097	267	43
18	399	9.49692	38	943	9.97746	4	072	9.51946	42	0.48054	237	42
19	427	9.49730	38	933	9.97742	4	104	9.51988	43	0.48012	208	41
20	31454	9.49768	38	94924	9.97738	4	33136	9.52031	42	0.47969	3.0178	40
21	482	9.49806	38	915	9.97734	4	169	9.52073	42	0.47927	149	39
22	510	9.49844	38	906	9.97729	5	201	9.52115	42	0.47885	120	38
23	537	9.49882	38	897	9.97725	4	233	9.52157	43	0.47843	090	37
24	565	9.49920	38	888	9.97721	4	266	9.52200	42	0.47800	061	36
25	31593	9.49958	38	94878	9.97717	4	33298	9.52242	42	0.47758	3.0032	35
26	620	9.49996	38	869	9.97713	4	330	9.52284	42	0.47716	003	34
27	648	9.50034	38	860	9.97708	5	363	9.52326	42	0.47674	2.9974	33
28	675	9.50072	38	851	9.97704	4	395	9.52368	42	0.47632	945	32
29	703	9.50110	38	842	9.97700	4	427	9.52410	42	0.47590	916	31
30	31730	9.50148	37	94832	9.97696	4	33460	9.52452	42	0.47548	2.9887	30
31	758	9.50185	38	823	9.97691	5	492	9.52494	42	0.47506	858	29
32	786	9.50223	38	814	9.97687	4	524	9.52536	42	0.47464	829	28
33	813	9.50261	37	805	9.97683	4	557	9.52578	42	0.47422	800	27
34	841	9.50298	38	795	9.97679	4	589	9.52620	42	0.47380	772	26
35	31868	9.50336	38	94786	9.97674	5	33621	9.52661	41	0.47339	2.9743	25
36	896	9.50374	37	777	9.97670	4	654	9.52703	42	0.47297	714	24
37	923	9.50411	38	768	9.97666	4	686	9.52745	42	0.47255	686	23
38	951	9.50449	37	758	9.97662	4	718	9.52787	42	0.47213	657	22
39	979	9.50486	37	749	9.97657	5	751	9.52829	42	0.47171	629	21
40	32006	9.50523	38	94740	9.97653	4	33783	9.52870	41	0.47130	2.9600	20
41	034	9.50561	37	730	9.97649	4	816	9.52912	42	0.47088	572	19
42	061	9.50598	37	721	9.97645	4	848	9.52953	41	0.47047	544	18
43	089	9.50635	38	712	9.97640	5	881	9.52995	42	0.47005	515	17
44	116	9.50673	37	702	9.97636	4	913	9.53037	42	0.46963	487	16
45	32144	9.50710	37	94693	9.97632	4	33945	9.53078	41	0.46922	2.9459	15
46	171	9.50747	37	684	9.97628	4	978	9.53120	42	0.46880	431	14
47	199	9.50784	37	674	9.97623	5	34010	9.53161	41	0.46839	403	13
48	227	9.50821	37	665	9.97619	4	043	9.53202	41	0.46798	375	12
49	254	9.50858	37	656	9.97615	4	075	9.53244	42	0.46756	347	11
50	32282	9.50896	38	94646	9.97610	5	34108	9.53285	41	0.46715	2.9319	10
51	309	9.50933	37	637	9.97606	4	140	9.53327	42	0.46673	291	9
52	337	9.50970	37	627	9.97602	4	173	9.53368	41	0.46632	263	8
53	364	9.51007	37	618	9.97597	5	205	9.53409	41	0.46591	235	7
54	392	9.51043	36	609	9.97593	4	238	9.53450	41	0.46550	208	6
55	32419	9.51080	37	94599	9.97589	4	34270	9.53492	42	0.46508	2.9180	5
56	447	9.51117	37	590	9.97584	5	303	9.53533	41	0.46467	152	4
57	474	9.51154	37	580	9.97580	4	335	9.53574	41	0.46426	125	3
58	502	9.51191	37	571	9.97576	4	368	9.53615	41	0.46385	097	2
59	529	9.51227	36	561	9.97571	5	400	9.53656	41	0.46344	070	1
60	557	9.51264	37	552	9.97567	4	433	9.53697	41	0.46303	042	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

19°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	32557	9.51264	37	94552	9.97567	4	34433	9.53697	41	0.46303	2.9042	60
1	584	9.51301	37	542	9.97563	4	465	9.53738	41	0.46262	015	59
2	612	9.51338	36	533	9.97558	5	498	9.53779	41	0.46221	2.8987	58
3	639	9.51374	37	523	9.97554	4	530	9.53820	41	0.46180	960	57
4	667	9.51411	36	514	9.97550	4	563	9.53861	41	0.46139	933	56
5	32694	9.51447	37	94504	9.97545	5	34596	9.53902	41	0.46098	2.8905	55
6	722	9.51484	36	495	9.97541	4	628	9.53943	41	0.46057	878	54
7	749	9.51520	37	485	9.97536	5	661	9.53984	41	0.46016	851	53
8	777	9.51557	36	476	9.97532	4	693	9.54025	40	0.45975	824	52
9	804	9.51593	36	466	9.97528	4	726	9.54065	41	0.45935	797	51
10	32832	9.51629	37	94457	9.97523	5	34758	9.54106	41	0.45894	2.8770	50
11	859	9.51666	36	447	9.97519	4	791	9.54147	40	0.45853	743	49
12	887	9.51702	36	438	9.97515	4	824	9.54187	41	0.45813	716	48
13	914	9.51738	36	428	9.97510	5	856	9.54228	41	0.45772	689	47
14	942	9.51774	37	418	9.97506	4	889	9.54269	41	0.45731	662	46
15	32969	9.51811	36	94409	9.97501	5	34922	9.54309	40	0.45691	2.8636	45
16	997	9.51847	36	399	9.97497	4	954	9.54350	41	0.45650	609	44
17	33024	9.51883	36	390	9.97492	5	987	9.54390	40	0.45610	582	43
18	051	9.51919	36	380	9.97488	4	35020	9.54431	41	0.45569	556	42
19	079	9.51955	36	370	9.97484	4	052	9.54471	40	0.45529	529	41
20	33106	9.51991	36	94361	9.97479	5	35085	9.54512	41	0.45488	2.8502	40
21	134	9.52027	36	351	9.97475	4	118	9.54552	40	0.45448	476	39
22	161	9.52063	36	342	9.97470	5	150	9.54593	41	0.45407	449	38
23	189	9.52099	36	332	9.97466	4	183	9.54633	40	0.45367	423	37
24	216	9.52135	36	322	9.97461	5	216	9.54673	40	0.45327	397	36
25	33244	9.52171	36	94313	9.97457	4	35248	9.54714	41	0.45286	2.8370	35
26	271	9.52207	35	303	9.97453	4	281	9.54754	40	0.45246	344	34
27	298	9.52242	36	293	9.97448	5	314	9.54794	40	0.45206	318	33
28	326	9.52278	36	284	9.97444	4	346	9.54835	41	0.45165	291	32
29	353	9.52314	36	274	9.97439	5	379	9.54875	40	0.45125	265	31
30	33381	9.52350	35	94264	9.97435	4	35412	9.54915	40	0.45085	2.8239	30
31	408	9.52385	36	254	9.97430	5	445	9.54955	40	0.45045	213	29
32	436	9.52421	35	245	9.97426	4	477	9.54995	40	0.45005	187	28
33	463	9.52456	36	235	9.97421	5	510	9.55035	40	0.44965	161	27
34	490	9.52492	35	225	9.97417	4	543	9.55075	40	0.44925	135	26
35	33518	9.52527	36	94215	9.97412	5	35576	9.55115	40	0.44885	2.8109	25
36	545	9.52563	35	206	9.97408	4	608	9.55155	40	0.44845	083	24
37	573	9.52598	36	196	9.97403	5	641	9.55195	40	0.44805	057	23
38	600	9.52634	35	186	9.97399	4	674	9.55235	40	0.44765	032	22
39	627	9.52669	36	176	9.97394	5	707	9.55275	40	0.44725	006	21
40	33655	9.52705	35	94167	9.97390	4	35740	9.55315	40	0.44685	2.7980	20
41	682	9.52740	35	157	9.97385	5	772	9.55355	40	0.44645	955	19
42	710	9.52775	36	147	9.97381	4	805	9.55395	39	0.44605	929	18
43	737	9.52811	35	137	9.97376	5	838	9.55434	40	0.44566	903	17
44	764	9.52846	35	127	9.97372	4	871	9.55474	40	0.44526	878	16
45	33792	9.52881	35	94118	9.97367	5	35904	9.55514	40	0.44486	2.7852	15
46	819	9.52916	35	108	9.97363	4	937	9.55554	39	0.44446	827	14
47	846	9.52951	35	098	9.97358	5	969	9.55593	40	0.44407	801	13
48	874	9.52986	35	088	9.97353	5	36002	9.55633	40	0.44367	776	12
49	901	9.53021	35	078	9.97349	4	035	9.55673	40	0.44327	751	11
50	33929	9.53056	36	94068	9.97344	5	36068	9.55712	39	0.44288	2.7725	10
51	956	9.53092	34	058	9.97340	4	101	9.55752	40	0.44248	700	9
52	983	9.53126	35	049	9.97335	5	134	9.55791	39	0.44209	675	8
53	34011	9.53161	35	039	9.97331	4	167	9.55831	40	0.44169	650	7
54	038	9.53196	35	029	9.97326	5	199	9.55870	39	0.44130	625	6
55	34065	9.53231	35	94019	9.97322	4	36232	9.55910	40	0.44090	2.7600	5
56	093	9.53266	35	009	9.97317	5	265	9.55949	39	0.44051	575	4
57	120	9.53301	35	93999	9.97312	5	298	9.55989	40	0.44011	550	3
58	147	9.53336	35	989	9.97308	4	331	9.56028	39	0.43972	525	2
59	175	9.53370	34	979	9.97303	5	364	9.56067	39	0.43933	500	1
60	202	9.53405	35	969	9.97299	4	397	9.56107	40	0.43893	475	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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20°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	34202	9.53405		93969	9.97299		36397	9.56107		0.43893	2.7475	60
1	229	9.53440	35	959	9.97294	5	430	9.56146	39	0.43854	450	59
2	257	9.53475	35	949	9.97289	5	463	9.56185	39	0.43815	425	58
3	284	9.53509	34	939	9.97285	4	496	9.56224	39	0.43776	400	57
4	311	9.53544	35	929	9.97280	5	529	9.56264	40	0.43736	376	56
5	34339	9.53578	34	93919	9.97276	4	36562	9.56303	39	0.43697	2.7351	55
6	366	9.53613	35	909	9.97271	5	595	9.56342	39	0.43658	326	54
7	393	9.53647	34	899	9.97266	5	628	9.56381	39	0.43619	302	53
8	421	9.53682	35	889	9.97262	4	661	9.56420	39	0.43580	277	52
9	448	9.53716	34	879	9.97257	5	694	9.56459	39	0.43541	253	51
10	34475	9.53751	35	93869	9.97252	5	36727	9.56498	39	0.43502	2.7228	50
11	503	9.53785	34	859	9.97248	4	760	9.56537	39	0.43463	204	49
12	530	9.53819	34	849	9.97243	5	793	9.56576	39	0.43424	179	48
13	557	9.53854	35	839	9.97238	5	826	9.56615	39	0.43385	155	47
14	584	9.53888	34	829	9.97234	4	859	9.56654	39	0.43346	130	46
15	34612	9.53922	34	93819	9.97229	5	36892	9.56693	39	0.43307	2.7106	45
16	639	9.53957	35	809	9.97224	5	925	9.56732	39	0.43268	082	44
17	666	9.53991	34	799	9.97220	4	958	9.56771	39	0.43229	058	43
18	694	9.54025	34	789	9.97215	5	991	9.56810	39	0.43190	034	42
19	721	9.54059	34	779	9.97210	5	37024	9.56849	39	0.43151	009	41
20	34748	9.54093	34	93769	9.97206	4	37057	9.56887	38	0.43113	2.6985	40
21	775	9.54127	34	759	9.97201	5	090	9.56926	39	0.43074	961	39
22	803	9.54161	34	748	9.97196	5	123	9.56965	39	0.43035	937	38
23	830	9.54195	34	738	9.97192	4	157	9.57004	39	0.42996	913	37
24	857	9.54229	34	728	9.97187	5	190	9.57042	38	0.42958	889	36
25	34884	9.54263	34	93718	9.97182	5	37223	9.57081	39	0.42919	2.6865	35
26	912	9.54297	34	708	9.97178	4	256	9.57120	39	0.42880	841	34
27	939	9.54331	34	698	9.97173	5	289	9.57158	38	0.42842	818	33
28	966	9.54365	34	688	9.97168	5	322	9.57197	39	0.42803	794	32
29	993	9.54399	34	677	9.97163	5	355	9.57235	38	0.42765	770	31
30	35021	9.54433	33	93667	9.97159	4	37388	9.57274	39	0.42726	2.6746	30
31	048	9.54466	34	657	9.97154	5	422	9.57312	38	0.42688	723	29
32	075	9.54500	34	647	9.97149	5	455	9.57351	39	0.42649	699	28
33	102	9.54534	33	637	9.97145	4	488	9.57389	38	0.42611	675	27
34	130	9.54567	34	626	9.97140	5	521	9.57428	39	0.42572	652	26
35	35157	9.54601	34	93616	9.97135	5	37554	9.57466	38	0.42534	2.6628	25
36	184	9.54635	33	606	9.97130	5	588	9.57504	38	0.42496	605	24
37	211	9.54668	34	596	9.97126	4	621	9.57543	39	0.42457	581	23
38	239	9.54702	33	585	9.97121	5	654	9.57581	38	0.42419	558	22
39	266	9.54735	34	575	9.97116	5	687	9.57619	38	0.42381	534	21
40	35293	9.54769	33	93565	9.97111	5	37720	9.57658	39	0.42342	2.6511	20
41	320	9.54802	34	555	9.97107	4	754	9.57696	38	0.42304	488	19
42	347	9.54836	33	544	9.97102	5	787	9.57734	38	0.42266	464	18
43	375	9.54869	34	534	9.97097	5	820	9.57772	38	0.42228	441	17
44	402	9.54903	33	524	9.97092	5	853	9.57810	38	0.42190	418	16
45	35429	9.54936	33	93514	9.97087	5	37887	9.57849	39	0.42151	2.6395	15
46	456	9.54969	33	503	9.97083	4	920	9.57887	38	0.42113	371	14
47	484	9.55003	34	493	9.97078	5	953	9.57925	38	0.42075	348	13
48	511	9.55036	33	483	9.97073	5	986	9.57963	38	0.42037	325	12
49	538	9.55069	33	472	9.97068	5	38020	9.58001	38	0.41999	302	11
50	35565	9.55102	33	93462	9.97063	5	38053	9.58039	38	0.41961	2.6279	10
51	592	9.55136	34	452	9.97059	4	086	9.58077	38	0.41923	256	9
52	619	9.55169	33	441	9.97054	5	120	9.58115	38	0.41885	233	8
53	647	9.55202	33	431	9.97049	5	153	9.58153	38	0.41847	210	7
54	674	9.55235	33	420	9.97044	5	186	9.58191	38	0.41809	187	6
55	35701	9.55268	33	93410	9.97039	5	38220	9.58229	38	0.41771	2.6165	5
56	728	9.55301	33	400	9.97035	4	253	9.58267	38	0.41733	142	4
57	755	9.55334	33	389	9.97030	5	286	9.58304	37	0.41696	119	3
58	782	9.55367	33	379	9.97025	5	320	9.58342	38	0.41658	096	2
59	810	9.55400	33	368	9.97020	5	353	9.58380	38	0.41620	074	1
60	837	9.55433	33	358	9.97015	5	386	9.58418	38	0.41582	051	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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21°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	′
0	35837	9.55433		93358	9.97015		38386	9.58418		0.41582	2.6051	60
1	864	9.55466	33	348	9.97010	5	420	9.58455	37	0.41545	028	59
2	891	9.55499	33	337	9.97005	5	453	9.58493	38	0.41507	006	58
3	918	9.55532	33	327	9.97001	4	487	9.58531	38	0.41469	2.5983	57
4	945	9.55564	32	316	9.96996	5	520	9.58569	38	0.41431	961	56
5	35973	9.55597	33	93306	9.96991	5	38553	9.58606	37	0.41394	2.5938	55
6	36000	9.55630	33	295	9.96986	5	587	9.58644	38	0.41356	916	54
7	027	9.55663	33	285	9.96981	5	620	9.58681	37	0.41319	893	53
8	054	9.55695	32	274	9.96976	5	654	9.58719	38	0.41281	871	52
9	081	9.55728	33	264	9.96971	5	687	9.58757	38	0.41243	848	51
10	36108	9.55761	33	93253	9.96966	5	38721	9.58794	37	0.41206	2.5826	50
11	135	9.55793	32	243	9.96962	4	754	9.58832	38	0.41168	804	49
12	162	9.55826	33	232	9.96957	5	787	9.58869	37	0.41131	782	48
13	190	9.55858	32	222	9.96952	5	821	9.58907	38	0.41093	759	47
14	217	9.55891	33	211	9.96947	5	854	9.58944	37	0.41056	737	46
15	36244	9.55923	32	93201	9.96942	5	38888	9.58981	37	0.41019	2.5715	45
16	271	9.55956	33	190	9.96937	5	921	9.59019	38	0.40981	693	44
17	298	9.55988	32	180	9.96932	5	955	9.59056	37	0.40944	671	43
18	325	9.56021	33	169	9.96927	5	988	9.59094	38	0.40906	649	42
19	352	9.56053	32	159	9.96922	5	39022	9.59131	37	0.40869	627	41
20	36379	9.56085	32	93148	9.96917	5	39055	9.59168	37	0.40832	2.5605	40
21	406	9.56118	33	137	9.96912	5	089	9.59205	37	0.40795	583	39
22	434	9.56150	32	127	9.96907	5	122	9.59243	38	0.40757	561	38
23	461	9.56182	32	116	9.96903	4	156	9.59280	37	0.40720	539	37
24	488	9.56215	33	106	9.96898	5	190	9.59317	37	0.40683	517	36
25	36515	9.56247	32	93095	9.96893	5	39223	9.59354	37	0.40646	2.5495	35
26	542	9.56279	32	084	9.96888	5	257	9.59391	37	0.40609	473	34
27	569	9.56311	32	074	9.96883	5	290	9.59429	38	0.40571	452	33
28	596	9.56343	32	063	9.96878	5	324	9.59466	37	0.40534	430	32
29	623	9.56375	32	052	9.96873	5	357	9.59503	37	0.40497	408	31
30	36650	9.56408	33	93042	9.96868	5	39391	9.59540	37	0.40460	2.5386	30
31	677	9.56440	32	031	9.96863	5	425	9.59577	37	0.40423	365	29
32	704	9.56472	32	020	9.96858	5	458	9.59614	37	0.40386	343	28
33	731	9.56504	32	010	9.96853	5	492	9.59651	37	0.40349	322	27
34	758	9.56536	32	92999	9.96848	5	526	9.59688	37	0.40312	300	26
35	36785	9.56568	31	92988	9.96843	5	39559	9.59725	37	0.40275	2.5279	25
36	812	9.56599	32	978	9.96838	5	593	9.59762	37	0.40238	257	24
37	839	9.56631	32	967	9.96833	5	626	9.59799	36	0.40201	236	23
38	867	9.56663	32	956	9.96828	5	660	9.59835	37	0.40165	214	22
39	894	9.56695	32	945	9.96823	5	694	9.59872	37	0.40128	193	21
40	36921	9.56727	32	92935	9.96818	5	39727	9.59909	37	0.40091	2.5172	20
41	948	9.56759	31	924	9.96813	5	761	9.59946	37	0.40054	150	19
42	975	9.56790	32	913	9.96808	5	795	9.59983	36	0.40017	129	18
43	37002	9.56822	32	902	9.96803	5	829	9.60019	37	0.39981	108	17
44	029	9.56854	32	892	9.96798	5	862	9.60056	37	0.39944	086	16
45	37056	9.56886	32	92881	9.96793	5	39896	9.60093	37	0.39907	2.5065	15
46	083	9.56917	31	870	9.96788	5	930	9.60130	36	0.39870	044	14
47	110	9.56949	32	859	9.96783	5	963	9.60166	37	0.39834	023	13
48	137	9.56980	31	849	9.96778	5	997	9.60203	37	0.39797	002	12
49	164	9.57012	32	838	9.96772	6	40031	9.60240	36	0.39760	2.4981	11
50	37191	9.57044	32	92827	9.96767	5	40065	9.60276	37	0.39724	2.4960	10
51	218	9.57075	31	816	9.96762	5	098	9.60313	36	0.39687	939	9
52	245	9.57107	32	805	9.96757	5	132	9.60349	37	0.39651	918	8
53	272	9.57138	31	794	9.96752	5	166	9.60386	36	0.39614	897	7
54	299	9.57169	31	784	9.96747	5	200	9.60422	36	0.39578	876	6
55	37326	9.57201	32	92773	9.96742	5	40234	9.60459	37	0.39541	2.4855	5
56	353	9.57232	31	762	9.96737	5	267	9.60495	36	0.39505	834	4
57	380	9.57264	32	751	9.96732	5	301	9.60532	37	0.39468	813	3
58	407	9.57295	31	740	9.96727	5	335	9.60568	36	0.39432	792	2
59	434	9.57326	31	729	9.96722	5	369	9.60605	37	0.39395	772	1
60	461	9.57358	32	718	9.96717	5	403	9.60641	36	0.39359	751	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	37461	9.57358	31	92718	9.96717	6	40403	9.60641	36	0.39359	2.4751	60
1	488	9.57389	31	707	9.96711	5	436	9.60677	37	0.39323	730	59
2	515	9.57420	31	697	9.96706	5	470	9.60714	36	0.39286	709	58
3	542	9.57451	31	686	9.96701	5	504	9.60750	36	0.39250	689	57
4	569	9.57482	31	675	9.96696	5	538	9.60786	36	0.39214	668	56
5	37595	9.57514	32	92664	9.96691	5	40572	9.60823	37	0.39177	2.4648	55
6	622	9.57545	31	653	9.96686	5	606	9.60859	36	0.39141	627	54
7	649	9.57576	31	642	9.96681	5	640	9.60895	36	0.39105	606	53
8	676	9.57607	31	631	9.96676	6	674	9.60931	36	0.39069	586	52
9	703	9.57638	31	620	9.96670	5	707	9.60967	36	0.39033	566	51
10	37730	9.57669	31	92609	9.96665	5	40741	9.61004	37	0.38996	2.4545	50
11	757	9.57700	31	598	9.96660	5	775	9.61040	36	0.38960	525	49
12	784	9.57731	31	587	9.96655	5	809	9.61076	36	0.38924	504	48
13	811	9.57762	31	576	9.96650	5	843	9.61112	36	0.38888	484	47
14	838	9.57793	31	565	9.96645	5	877	9.61148	36	0.38852	464	46
15	37865	9.57824	31	92554	9.96640	6	40911	9.61184	36	0.38816	2.4443	45
16	892	9.57855	30	543	9.96634	5	945	9.61220	36	0.38780	423	44
17	919	9.57885	31	532	9.96629	5	979	9.61256	36	0.38744	403	43
18	946	9.57916	31	521	9.96624	5	41013	9.61292	36	0.38708	383	42
19	973	9.57947	31	510	9.96619	5	047	9.61328	36	0.38672	362	41
20	37999	9.57978	31	92499	9.96614	5	41081	9.61364	36	0.38636	2.4342	40
21	38026	9.58008	30	488	9.96608	6	115	9.61400	36	0.38600	322	39
22	053	9.58039	31	477	9.96603	5	149	9.61436	36	0.38564	302	38
23	080	9.58070	31	466	9.96598	5	183	9.61472	36	0.38528	282	37
24	107	9.58101	31	455	9.96593	5	217	9.61508	36	0.38492	262	36
25	38134	9.58131	30	92444	9.96588	5	41251	9.61544	36	0.38456	2.4242	35
26	161	9.58162	31	432	9.96582	6	285	9.61579	35	0.38421	222	34
27	188	9.58192	30	421	9.96577	5	319	9.61615	36	0.38385	202	33
28	215	9.58223	31	410	9.96572	5	353	9.61651	36	0.38349	182	32
29	241	9.58253	30	399	9.96567	5	387	9.61687	36	0.38313	162	31
30	38268	9.58284	31	92388	9.96562	5	41421	9.61722	35	0.38278	2.4142	30
31	295	9.58314	30	377	9.96556	6	455	9.61758	36	0.38242	122	29
32	322	9.58345	31	366	9.96551	5	490	9.61794	36	0.38206	102	28
33	349	9.58375	30	355	9.96546	5	524	9.61830	36	0.38170	083	27
34	376	9.58406	31	343	9.96541	5	558	9.61865	35	0.38135	063	26
35	38403	9.58436	30	92332	9.96535	6	41592	9.61901	36	0.38099	2.4043	25
36	430	9.58467	31	321	9.96530	5	626	9.61936	35	0.38064	023	24
37	456	9.58497	30	310	9.96525	5	660	9.61972	36	0.38028	004	23
38	483	9.58527	30	299	9.96520	5	694	9.62008	36	0.37992	2.3984	22
39	510	9.58557	30	287	9.96514	6	728	9.62043	35	0.37957	964	21
40	38537	9.58588	31	92276	9.96509	5	41763	9.62079	36	0.37921	2.3945	20
41	564	9.58618	30	265	9.96504	5	797	9.62114	35	0.37886	925	19
42	591	9.58648	30	254	9.96498	6	831	9.62150	36	0.37850	906	18
43	617	9.58678	30	243	9.96493	5	865	9.62185	35	0.37815	886	17
44	644	9.58709	31	231	9.96488	5	899	9.62221	36	0.37779	867	16
45	38671	9.58739	30	92220	9.96483	5	41933	9.62256	35	0.37744	2.3847	15
46	698	9.58769	30	209	9.96477	6	968	9.62292	36	0.37708	828	14
47	725	9.58799	30	198	9.96472	5	42002	9.62327	35	0.37673	808	13
48	752	9.58829	30	186	9.96467	5	036	9.62362	35	0.37638	789	12
49	778	9.58859	30	175	9.96461	6	070	9.62398	36	0.37602	770	11
50	38805	9.58889	30	92164	9.96456	5	42105	9.62433	35	0.37567	2.3750	10
51	832	9.58919	30	152	9.96451	5	139	9.62468	35	0.37532	731	9
52	859	9.58949	30	141	9.96445	6	173	9.62504	36	0.37496	712	8
53	886	9.58979	30	130	9.96440	5	207	9.62539	35	0.37461	693	7
54	912	9.59009	30	119	9.96435	5	242	9.62574	35	0.37426	673	6
55	38939	9.59039	30	92107	9.96429	6	42276	9.62609	35	0.37391	2.3654	5
56	966	9.59069	29	096	9.96424	5	310	9.62645	36	0.37355	635	4
57	993	9.59098	30	085	9.96419	5	345	9.62680	35	0.37320	616	3
58	39020	9.59128	30	073	9.96413	6	379	9.62715	35	0.37285	597	2
59	046	9.59158	30	062	9.96408	5	413	9.62750	35	0.37250	578	1
60	073	9.59188	30	050	9.96403	5	447	9.62785	35	0.37215	559	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat Tan	Log.	c.d.	Log. Cot	Nat.	
0	39073	9.59188		92050	9.96403		42447	9.62785		0.37215	2.3559	60
1	100	9.59218	30	039	9.96397	6	482	9.62820	35	0.37180	539	59
2	127	9.59247	29	028	9.96392	5	516	9.62855	35	0.37145	520	58
3	153	9.59277	30	016	9.96387	5	551	9.62890	35	0.37110	501	57
4	180	9.59307	30	005	9.96381	6	585	9.62926	36	0.37074	483	56
5	39207	9.59336	29	91994	9.96376	5	42619	9.62961	35	0.37039	2.3464	55
6	234	9.59366	30	982	9.96370	6	654	9.62996	35	0.37004	445	54
7	260	9.59396	30	971	9.96365	5	688	9.63031	35	0.36969	426	53
8	287	9.59425	29	959	9.96360	5	722	9.63066	35	0.36934	407	52
9	314	9.59455	30	948	9.96354	6	757	9.63101	35	0.36899	388	51
10	39341	9.59484	29	91936	9.96349	5	42791	9.63135	34	0.36865	2.3369	50
11	367	9.59514	30	925	9.96343	6	826	9.63170	35	0.36830	351	49
12	394	9.59543	29	914	9.96338	5	860	9.63205	35	0.36795	332	48
13	421	9.59573	30	902	9.96333	5	894	9.63240	35	0.36760	313	47
14	448	9.59602	29	891	9.96327	6	929	9.63275	35	0.36725	294	46
15	39474	9.59632	30	91879	9.96322	5	42963	9.63310	35	0.36690	2.3276	45
16	501	9.59661	29	868	9.96316	6	998	9.63345	35	0.36655	257	44
17	528	9.59690	29	856	9.96311	5	43032	9.63379	34	0.36621	238	43
18	555	9.59720	30	845	9.96305	6	067	9.63414	35	0.36586	220	42
19	581	9.59749	29	833	9.96300	5	101	9.63449	35	0.36551	201	41
20	39608	9.59778	29	91822	9.96294	6	43136	9.63484	35	0.36516	2.3183	40
21	635	9.59808	30	810	9.96289	5	170	9.63519	35	0.36481	164	39
22	661	9.59837	29	799	9.96284	5	205	9.63553	34	0.36447	146	38
23	688	9.59866	29	787	9.96278	6	239	9.63588	35	0.36412	127	37
24	715	9.59895	29	775	9.96273	5	274	9.63623	35	0.36377	109	36
25	39741	9.59924	29	91764	9.96267	6	43308	9.63657	34	0.36343	2.3090	35
26	768	9.59954	30	752	9.96262	5	343	9.63692	35	0.36308	072	34
27	795	9.59983	29	741	9.96256	6	378	9.63726	34	0.36274	053	33
28	822	9.60012	29	729	9.96251	5	412	9.63761	35	0.36239	035	32
29	848	9.60041	29	718	9.96245	6	447	9.63796	35	0.36204	017	31
30	39875	9.60070	29	91706	9.96240	5	43481	9.63830	34	0.36170	2.2998	30
31	902	9.60099	29	694	9.96234	6	516	9.63865	35	0.36135	980	29
32	928	9.60128	29	683	9.96229	5	550	9.63899	34	0.36101	962	28
33	955	9.60157	29	671	9.96223	6	585	9.63934	35	0.36066	944	27
34	982	9.60186	29	660	9.96218	5	620	9.63968	34	0.36032	925	26
35	40008	9.60215	29	91648	9.96212	6	43654	9.64003	35	0.35997	2.2907	25
36	035	9.60244	29	636	9.96207	5	689	9.64037	34	0.35963	889	24
37	062	9.60273	29	625	9.96201	6	724	9.64072	35	0.35928	871	23
38	088	9.60302	29	613	9.96196	5	758	9.64106	34	0.35894	853	22
39	115	9.60331	29	601	9.96190	6	793	9.64140	34	0.35860	835	21
40	40141	9.60359	28	91590	9.96185	5	43828	9.64175	35	0.35825	2.2817	20
41	168	9.60388	29	578	9.96179	6	862	9.64209	34	0.35791	799	19
42	195	9.60417	29	566	9.96174	5	897	9.64243	34	0.35757	781	18
43	221	9.60446	29	555	9.96168	6	932	9.64278	35	0.35722	763	17
44	248	9.60474	28	543	9.96162	6	966	9.64312	34	0.35688	745	16
45	40275	9.60503	29	91531	9.96157	5	44001	9.64346	34	0.35654	2.2727	15
46	301	9.60532	29	519	9.96151	6	036	9.64381	35	0.35619	709	14
47	328	9.60561	29	508	9.96146	5	071	9.64415	34	0.35585	691	13
48	355	9.60589	28	496	9.96140	6	105	9.64449	34	0.35551	673	12
49	381	9.60618	29	484	9.96135	5	140	9.64483	34	0.35517	655	11
50	40408	9.60646	28	91472	9.96129	6	44175	9.64517	34	0.35483	2.2637	10
51	434	9.60675	29	461	9.96123	6	210	9.64552	35	0.35448	620	9
52	461	9.60704	29	449	9.96118	5	244	9.64586	34	0.35414	602	8
53	488	9.60732	28	437	9.96112	6	279	9.64620	34	0.35380	584	7
54	514	9.60761	29	425	9.96107	5	314	9.64654	34	0.35346	566	6
55	40541	9.60789	28	91414	9.96101	6	44349	9.64688	34	0.35312	2.2549	5
56	567	9.60818	29	402	9.96095	6	384	9.64722	34	0.35278	531	4
57	594	9.60846	28	390	9.96090	5	418	9.64756	34	0.35244	513	3
58	621	9.60875	29	378	9.96084	6	453	9.64790	34	0.35210	496	2
59	647	9.60903	28	366	9.96079	5	488	9.64824	34	0.35176	478	1
60	674	9.60931	28	355	9.96073	6	523	9.64858	34	0.35142	460	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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24°

′	Nat. **Sin** Log.	d.	Nat. **Cos** Log.	d.	Nat. **Tan** Log.	c.d.	Log. **Cot** Nat.	
0	40674 9.60931	29	91355 9.96073	6	44523 9.64858	34	0.35142 2.2460	60
1	700 9.60960	28	343 9.96067	5	558 9.64892	34	0.35108 443	59
2	727 9.60988	28	331 9.96062	6	593 9.64926	34	0.35074 425	58
3	753 9.61016	29	319 9.96056	6	627 9.64960	34	0.35040 408	57
4	780 9.61045	28	307 9.96050	5	662 9.64994	34	0.35006 390	56
5	40806 9.61073	28	91295 9.96045	6	44697 9.65028	34	0.34972 2.2373	55
6	833 9.61101	28	283 9.96039	5	732 9.65062	34	0.34938 355	54
7	860 9.61129	29	272 9.96034	6	767 9.65096	34	0.34904 338	53
8	886 9.61158	28	260 9.96028	6	802 9.65130	34	0.34870 320	52
9	913 9.61186	28	248 9.96022	5	837 9.65164	33	0.34836 303	51
10	40939 9.61214	28	91236 9.96017	6	44872 9.65197	34	0.34803 2.2286	50
11	966 9.61242	28	224 9.96011	6	907 9.65231	34	0.34769 268	49
12	992 9.61270	28	212 9.96005	5	942 9.65265	34	0.34735 251	48
13	41019 9.61298	28	200 9.96000	6	977 9.65299	34	0.34701 234	47
14	045 9.61326	28	188 9.95994	6	45012 9.65333	33	0.34667 216	46
15	41072 9.61354	28	91176 9.95988	6	45047 9.65366	34	0.34634 2.2199	45
16	098 9.61382	29	164 9.95982	6	082 9.65400	34	0.34600 182	44
17	125 9.61411	27	152 9.95977	5	117 9.65434	34	0.34566 165	43
18	151 9.61438	28	140 9.95971	6	152 9.65467	33	0.34533 148	42
19	178 9.61466	28	128 9.95965	6	187 9.65501	34	0.34499 130	41
20	41204 9.61494	28	91116 9.95960	5	45222 9.65535	34	0.34465 2.2113	40
21	231 9.61522	28	104 9.95954	6	257 9.65568	33	0.34432 096	39
22	257 9.61550	28	092 9.95948	6	292 9.65602	34	0.34398 079	38
23	284 9.61578	28	080 9.95942	6	327 9.65636	34	0.34364 062	37
24	310 9.61606	28	068 9.95937	5	362 9.65669	33	0.34331 045	36
25	41337 9.61634	28	91056 9.95931	6	45397 9.65703	34	0.34297 2.2028	35
26	363 9.61662	27	044 9.95925	6	432 9.65736	33	0.34264 011	34
27	390 9.61689	28	032 9.95920	5	467 9.65770	34	0.34230 2.1994	33
28	416 9.61717	28	020 9.95914	6	502 9.65803	33	0.34197 977	32
29	443 9.61745	28	008 9.95908	6	538 9.65837	34	0.34163 960	31
30	41469 9.61773	27	90996 9.95902	5	45573 9.65870	33	0.34130 2.1943	30
31	496 9.61800	28	984 9.95897	6	608 9.65904	34	0.34096 926	29
32	522 9.61828	28	972 9.95891	6	643 9.65937	33	0.34063 909	28
33	549 9.61856	27	960 9.95885	6	678 9.65971	34	0.34029 892	27
34	575 9.61883	28	948 9.95879	6	713 9.66004	33	0.33996 876	26
35	41602 9.61911	28	90936 9.95873	5	45748 9.66038	34	0.33962 2.1859	25
36	628 9.61939	27	924 9.95868	6	784 9.66071	33	0.33929 842	24
37	655 9.61966	28	911 9.95862	6	819 9.66104	33	0.33896 825	23
38	681 9.61994	27	899 9.95856	6	854 9.66138	34	0.33862 808	22
39	707 9.62021	28	887 9.95850	6	889 9.66171	33	0.33829 792	21
40	41734 9.62049	27	90875 9.95844	5	45924 9.66204	33	0.33796 2.1775	20
41	760 9.62076	28	863 9.95839	6	960 9.66238	34	0.33762 758	19
42	787 9.62104	27	851 9.95833	6	995 9.66271	33	0.33729 742	18
43	813 9.62131	28	839 9.95827	6	46030 9.66304	33	0.33696 725	17
44	840 9.62159	27	826 9.95821	6	065 9.66337	33	0.33663 708	16
45	41866 9.62186	28	90814 9.95815	5	46101 9.66371	34	0.33629 2.1692	15
46	892 9.62214	27	802 9.95810	6	136 9.66404	33	0.33596 675	14
47	919 9.62241	27	790 9.95804	6	171 9.66437	33	0.33563 659	13
48	945 9.62268	28	778 9.95798	6	206 9.66470	33	0.33530 642	12
49	972 9.62296	27	766 9.95792	6	242 9.66503	33	0.33497 625	11
50	41998 9.62323	27	90753 9.95786	6	46277 9.66537	34	0.33463 2.1609	10
51	42024 9.62350	27	741 9.95780	5	312 9.66570	33	0.33430 592	9
52	051 9.62377	28	729 9.95775	6	348 9.66603	33	0.33397 576	8
53	077 9.62405	27	717 9.95769	6	383 9.66636	33	0.33364 560	7
54	104 9.62432	27	704 9.95763	6	418 9.66669	33	0.33331 543	6
55	42130 9.62459	27	90692 9.95757	6	46454 9.66702	33	0.33298 2.1527	5
56	156 9.62486	27	680 9.95751	6	489 9.66735	33	0.33265 510	4
57	183 9.62513	28	668 9.95745	6	525 9.66768	33	0.33232 494	3
58	209 9.62541	27	655 9.95739	6	560 9.66801	33	0.33199 478	2
59	235 9.62568	27	643 9.95733	6	595 9.66834	33	0.33166 461	1
60	262 9.62595		631 9.95728	5	631 9.66867		0.33133 445	0
	Nat. **Cos** Log.	d.	Nat. **Sin** Log.	d.	Nat. **Cot** Log.	c.d.	Log. **Tan** Nat.	′

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25°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	42262	9.62595	27	90631	9.95728	6	46631	9.66867	33	0.33133	2.1445	60
1	288	9.62622	27	618	9.95722	6	666	9.66900	33	0.33100	429	59
2	315	9.62649	27	606	9.95716	6	702	9.66933	33	0.33067	413	58
3	341	9.62676	27	594	9.95710	6	737	9.66966	33	0.33034	396	57
4	367	9.62703	27	582	9.95704	6	772	9.66999	33	0.33001	380	56
5	42394	9.62730	27	90569	9.95698	6	46808	9.67032	33	0.32968	2.1364	55
6	420	9.62757	27	557	9.95692	6	843	9.67065	33	0.32935	348	54
7	446	9.62784	27	545	9.95686	6	879	9.67098	33	0.32902	332	53
8	473	9.62811	27	532	9.95680	6	914	9.67131	33	0.32869	315	52
9	499	9.62838	27	520	9.95674	6	950	9.67163	32	0.32837	299	51
10	42525	9.62865	27	90507	9.95668	5	46985	9.67196	33	0.32804	2.1283	50
11	552	9.62892	27	495	9.95663	6	47021	9.67229	33	0.32771	267	49
12	578	9.62918	26	483	9.95657	6	056	9.67262	33	0.32738	251	48
13	604	9.62945	27	470	9.95651	6	092	9.67295	33	0.32705	235	47
14	631	9.62972	27	458	9.95645	6	128	9.67327	32	0.32673	219	46
15	42657	9.62999	27	90446	9.95639	6	47163	9.67360	33	0.32640	2.1203	45
16	683	9.63026	26	433	9.95633	6	199	9.67393	33	0.32607	187	44
17	709	9.63052	27	421	9.95627	6	234	9.67426	33	0.32574	171	43
18	736	9.63079	27	408	9.95621	6	270	9.67458	32	0.32542	155	42
19	762	9.63106	27	396	9.95615	6	305	9.67491	33	0.32509	139	41
20	42788	9.63133	26	90383	9.95609	6	47341	9.67524	33	0.32476	2.1123	40
21	815	9.63159	27	371	9.95603	6	377	9.67556	32	0.32444	107	39
22	841	9.63186	27	358	9.95597	6	412	9.67589	33	0.32411	092	38
23	867	9.63213	26	346	9.95591	6	448	9.67622	33	0.32378	076	37
24	894	9.63239	27	334	9.95585	6	483	9.67654	32	0.32346	060	36
25	42920	9.63266	26	90321	9.95579	6	47519	9.67687	33	0.32313	2.1044	35
26	946	9.63292	27	309	9.95573	6	555	9.67719	32	0.32281	028	34
27	972	9.63319	26	296	9.95567	6	590	9.67752	33	0.32248	013	33
28	999	9.63345	27	284	9.95561	6	626	9.67785	33	0.32215	2.0997	32
29	43025	9.63372	26	271	9.95555	6	662	9.67817	32	0.32183	981	31
30	43051	9.63398	27	90259	9.95549	6	47698	9.67850	33	0.32150	2.0965	30
31	077	9.63425	26	246	9.95543	6	733	9.67882	32	0.32118	950	29
32	104	9.63451	27	233	9.95537	6	769	9.67915	33	0.32085	934	28
33	130	9.63478	26	221	9.95531	6	805	9.67947	32	0.32053	918	27
34	156	9.63504	27	208	9.95525	6	840	9.67980	33	0.32020	903	26
35	43182	9.63531	26	90196	9.95519	6	47876	9.68012	32	0.31988	2.0887	25
36	209	9.63557	26	183	9.95513	6	912	9.68044	32	0.31956	872	24
37	235	9.63583	27	171	9.95507	7	948	9.68077	33	0.31923	856	23
38	261	9.63610	26	158	9.95500	6	984	9.68109	32	0.31891	840	22
39	287	9.63636	26	146	9.95494	6	48019	9.68142	33	0.31858	825	21
40	43313	9.63662	27	90133	9.95488	6	48055	9.68174	32	0.31826	2.0809	20
41	340	9.63689	26	120	9.95482	6	091	9.68206	32	0.31794	794	19
42	366	9.63715	26	108	9.95476	6	127	9.68239	33	0.31761	778	18
43	392	9.63741	26	095	9.95470	6	163	9.68271	32	0.31729	763	17
44	418	9.63767	27	082	9.95464	6	198	9.68303	32	0.31697	748	16
45	43445	9.63794	26	90070	9.95458	6	48234	9.68336	33	0.31664	2.0732	15
46	471	9.63820	26	057	9.95452	6	270	9.68368	32	0.31632	717	14
47	497	9.63846	26	045	9.95446	6	306	9.68400	32	0.31600	701	13
48	523	9.63872	26	032	9.95440	6	342	9.68432	32	0.31568	686	12
49	549	9.63898	26	019	9.95434	7	378	9.68465	33	0.31535	671	11
50	43575	9.63924	26	90007	9.95427	6	48414	9.68497	32	0.31503	2.0655	10
51	602	9.63950	26	89994	9.95421	6	450	9.68529	32	0.31471	640	9
52	628	9.63976	26	981	9.95415	6	486	9.68561	32	0.31439	625	8
53	654	9.64002	26	968	9.95409	6	521	9.68593	32	0.31407	609	7
54	680	9.64028	26	956	9.95403	6	557	9.68626	32	0.31374	594	6
55	43706	9.64054	26	89943	9.95397	6	48593	9.68658	32	0.31342	2.0579	5
56	733	9.64080	26	930	9.95391	7	629	9.68690	32	0.31310	564	4
57	759	9.64106	26	918	9.95384	6	665	9.68722	32	0.31278	549	3
58	785	9.64132	26	905	9.95378	6	701	9.68754	32	0.31246	533	2
59	811	9.64158	26	892	9.95372	6	737	9.68786	32	0.31214	518	1
60	837	9.64184		879	9.95366	6	773	9.68818	32	0.31182	503	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	43837	9.64184	26	89879	9.95366	6	48773	9.68818	32	0.31182	2.0503	60
1	863	9.64210	26	867	9.95360	6	809	9.68850	32	0.31150	488	59
2	889	9.64236	26	854	9.95354	6	845	9.68882	32	0.31118	473	58
3	916	9.64262	26	841	9.95348	7	881	9.68914	32	0.31086	458	57
4	942	9.64288	25	828	9.95341	6	917	9.68946	32	0.31054	443	56
5	43968	9.64313	26	89816	9.95335	6	48953	9.68978	32	0.31022	2.0428	55
6	994	9.64339	26	803	9.95329	6	989	9.69010	32	0.30990	413	54
7	44020	9.64365	26	790	9.95323	6	49026	9.69042	32	0.30958	398	53
8	046	9.64391	26	777	9.95317	7	062	9.69074	32	0.30926	383	52
9	072	9.64417	25	764	9.95310	6	098	9.69106	32	0.30894	368	51
10	44098	9.64442	26	89752	9.95304	6	49134	9.69138	32	0.30862	2.0353	50
11	124	9.64468	26	739	9.95298	6	170	9.69170	32	0.30830	338	49
12	151	9.64494	26	726	9.95292	6	206	9.69202	32	0.30798	323	48
13	177	9.64519	25	713	9.95286	7	242	9.69234	32	0.30766	308	47
14	203	9.64545	26	700	9.95279	6	278	9.69266	32	0.30734	293	46
15	44229	9.64571	25	89687	9.95273	6	49315	9.69298	31	0.30702	2.0278	45
16	255	9.64596	26	674	9.95267	6	351	9.69329	32	0.30671	263	44
17	281	9.64622	25	662	9.95261	7	387	9.69361	32	0.30639	248	43
18	307	9.64647	26	649	9.95254	6	423	9.69393	32	0.30607	233	42
19	333	9.64673	25	636	9.95248	6	459	9.69425	32	0.30575	219	41
20	44359	9.64698	26	89623	9.95242	6	49495	9.69457	32	0.30543	2.0204	40
21	385	9.64724	25	610	9.95236	7	532	9.69488	31	0.30512	189	39
22	411	9.64749	26	597	9.95229	6	568	9.69520	32	0.30480	174	38
23	437	9.64775	25	584	9.95223	6	604	9.69552	32	0.30448	160	37
24	464	9.64800	26	571	9.95217	6	640	9.69584	32	0.30416	145	36
25	44490	9.64826	25	89558	9.95211	7	49677	9.69615	31	0.30385	2.0130	35
26	516	9.64851	26	545	9.95204	6	713	9.69647	32	0.30353	115	34
27	542	9.64877	25	532	9.95198	6	749	9.69679	32	0.30321	101	33
28	568	9.64902	25	519	9.95192	7	786	9.69710	31	0.30290	086	32
29	594	9.64927	26	506	9.95185	6	822	9.69742	32	0.30258	072	31
30	44620	9.64953	25	89493	9.95179	6	49858	9.69774	32	0.30226	2.0057	30
31	646	9.64978	25	480	9.95173	6	894	9.69805	31	0.30195	042	29
32	672	9.65003	26	467	9.95167	7	931	9.69837	32	0.30163	028	28
33	698	9.65029	25	454	9.95160	6	967	9.69868	31	0.30132	013	27
34	724	9.65054	25	441	9.95154	6	50004	9.69900	32	0.30100	1.9999	26
35	44750	9.65079	25	89428	9.95148	7	50040	9.69932	32	0.30068	1.9984	25
36	776	9.65104	26	415	9.95141	6	076	9.69963	31	0.30037	970	24
37	802	9.65130	25	402	9.95135	6	113	9.69995	32	0.30005	955	23
38	828	9.65155	25	389	9.95129	6	149	9.70026	31	0.29974	941	22
39	854	9.65180	25	376	9.95122	7	185	9.70058	32	0.29942	926	21
40	44880	9.65205	25	89363	9.95116	6	50222	9.70089	31	0.29911	1.9912	20
41	906	9.65230	25	350	9.95110	7	258	9.70121	32	0.29879	897	19
42	932	9.65255	26	337	9.95103	6	295	9.70152	31	0.29848	883	18
43	958	9.65281	25	324	9.95097	6	331	9.70184	32	0.29816	868	17
44	984	9.65306	25	311	9.95090	7	368	9.70215	31	0.29785	854	16
45	45010	9.65331	25	89298	9.95084	6	50404	9.70247	32	0.29753	1.9840	15
46	036	9.65356	25	285	9.95078	6	441	9.70278	31	0.29722	825	14
47	062	9.65381	25	272	9.95071	7	477	9.70309	31	0.29691	811	13
48	088	9.65406	25	259	9.95065	6	514	9.70341	32	0.29659	797	12
49	114	9.65431	25	245	9.95059	6	550	9.70372	31	0.29628	782	11
50	45140	9.65456	25	89232	9.95052	7	50587	9.70404	32	0.29596	1.9768	10
51	166	9.65481	25	219	9.95046	6	623	9.70435	31	0.29565	754	9
52	192	9.65506	25	206	9.95039	7	660	9.70466	31	0.29534	740	8
53	218	9.65531	25	193	9.95033	6	696	9.70498	32	0.29502	725	7
54	243	9.65556	24	180	9.95027	6	733	9.70529	31	0.29471	711	6
55	45269	9.65580	25	89167	9.95020	7	50769	9.70560	31	0.29440	1.9697	5
56	295	9.65605	25	153	9.95014	6	806	9.70592	32	0.29408	683	4
57	321	9.65630	25	140	9.95007	7	843	9.70623	31	0.29377	669	3
58	347	9.65655	25	127	9.95001	6	879	9.70654	31	0.29346	654	2
59	373	9.65680	25	114	9.94995	6	916	9.70685	31	0.29315	640	1
60	399	9.65705	25	101	9.94988	7	953	9.70717	32	0.29283	626	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat Tan	Log.	c.d.	Log. Cot	Nat.	
0	45399	9.65705	24	89101	9.94988	6	50953	9.70717	31	0.29283	1.9626	60
1	425	9.65729	25	087	9.94982	7	989	9.70748	31	0.29252	612	59
2	451	9.65754	25	074	9.94975	6	51026	9.70779	31	0.29221	598	58
3	477	9.65779	25	061	9.94969	7	063	9.70810	31	0.29190	584	57
4	503	9.65804	24	048	9.94962	6	099	9.70841	32	0.29159	570	56
5	45529	9.65828	25	89035	9.94956	7	51136	9.70873	31	0.29127	1.9556	55
6	554	9.65853	25	021	9.94949	6	173	9.70904	31	0.29096	542	54
7	580	9.65878	24	008	9.94943	7	209	9.70935	31	0.29065	528	53
8	606	9.65902	25	88995	9.94936	6	246	9.70966	31	0.29034	514	52
9	632	9.65927	25	981	9.94930	7	283	9.70997	31	0.29003	500	51
10	45658	9.65952	24	88968	9.94923	6	51319	9.71028	31	0.28972	1.9486	50
11	684	9.65976	25	955	9.94917	6	356	9.71059	31	0.28941	472	49
12	710	9.66001	24	942	9.94911	7	393	9.71090	31	0.28910	458	48
13	736	9.66025	25	928	9.94904	6	430	9.71121	32	0.28879	444	47
14	762	9.66050	25	915	9.94898	7	467	9.71153	31	0.28847	430	46
15	45787	9.66075	24	88902	9.94891	6	51503	9.71184	31	0.28816	1.9416	45
16	813	9.66099	25	888	9.94885	7	540	9.71215	31	0.28785	402	44
17	839	9.66124	24	875	9.94878	7	577	9.71246	31	0.28754	388	43
18	865	9.66148	25	862	9.94871	6	614	9.71277	31	0.28723	375	42
19	891	9.66173	24	848	9.94865	7	651	9.71308	31	0.28692	361	41
20	45917	9.66197	24	88835	9.94858	6	51688	9.71339	31	0.28661	1.9347	40
21	942	9.66221	25	822	9.94852	7	724	9.71370	31	0.28630	333	39
22	968	9.66246	24	808	9.94845	6	761	9.71401	30	0.28599	319	38
23	994	9.66270	25	795	9.94839	7	798	9.71431	31	0.28569	306	37
24	46020	9.66295	24	782	9.94832	6	835	9.71462	31	0.28538	292	36
25	46046	9.66319	24	88768	9.94826	7	51872	9.71493	31	0.28507	1.9278	35
26	072	9.66343	25	755	9.94819	6	909	9.71524	31	0.28476	265	34
27	097	9.66368	24	741	9.94813	7	946	9.71555	31	0.28445	251	33
28	123	9.66392	24	728	9.94806	7	983	9.71586	31	0.28414	237	32
29	149	9.66416	25	715	9.94799	6	52020	9.71617	31	0.28383	223	31
30	46175	9.66441	24	88701	9.94793	7	52057	9.71648	31	0.28352	1.9210	30
31	201	9.66465	24	688	9.94786	6	094	9.71679	30	0.28321	196	29
32	226	9.66489	24	674	9.94780	7	131	9.71709	31	0.28291	183	28
33	252	9.66513	24	661	9.94773	6	168	9.71740	31	0.28260	169	27
34	278	9.66537	25	647	9.94767	7	205	9.71771	31	0.28229	155	26
35	46304	9.66562	24	88634	9.94760	7	52242	9.71802	31	0.28198	1.9142	25
36	330	9.66586	24	620	9.94753	6	279	9.71833	30	0.28167	128	24
37	355	9.66610	24	607	9.94747	7	316	9.71863	31	0.28137	115	23
38	381	9.66634	24	593	9.94740	6	353	9.71894	31	0.28106	101	22
39	407	9.66658	24	580	9.94734	7	390	9.71925	30	0.28075	088	21
40	46433	9.66682	24	88566	9.94727	7	52427	9.71955	31	0.28045	1.9074	20
41	458	9.66706	25	553	9.94720	6	464	9.71986	31	0.28014	061	19
42	484	9.66731	24	539	9.94714	7	501	9.72017	31	0.27983	047	18
43	510	9.66755	24	526	9.94707	7	538	9.72048	30	0.27952	034	17
44	536	9.66779	24	512	9.94700	6	575	9.72078	31	0.27922	020	16
45	46561	9.66803	24	88499	9.94694	7	52613	9.72109	31	0.27891	1.9007	15
46	587	9.66827	24	485	9.94687	7	650	9.72140	30	0.27860	1.8993	14
47	613	9.66851	24	472	9.94680	6	687	9.72170	31	0.27830	980	13
48	639	9.66875	24	458	9.94674	7	724	9.72201	30	0.27799	967	12
49	664	9.66899	23	445	9.94667	7	761	9.72231	31	0.27769	953	11
50	46690	9.66922	24	88431	9.94660	7	52798	9.72262	31	0.27738	1.8940	10
51	716	9.66946	24	417	9.94654	6	836	9.72293	30	0.27707	927	9
52	742	9.66970	24	404	9.94647	7	873	9.72323	31	0.27677	913	8
53	767	9.66994	24	390	9.94640	7	910	9.72354	30	0.27646	900	7
54	793	9.67018	24	377	9.94634	6	947	9.72384	30	0.27616	887	6
55	46819	9.67042	24	88363	9.94627	7	52985	9.72415	31	0.27585	1.8873	5
56	844	9.67066	24	349	9.94620	7	53022	9.72445	30	0.27555	860	4
57	870	9.67090	24	336	9.94614	6	059	9.72476	31	0.27524	847	3
58	896	9.67113	23	322	9.94607	7	096	9.72506	30	0.27494	834	2
59	921	9.67137	24	308	9.94600	7	134	9.72537	31	0.27463	820	1
60	947	9.67161	24	295	9.94593	7	171	9.72567	30	0.27433	807	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	46947	9.67161	24	88295	9.94593	6	53171	9.72567	31	0.27433	1.8807	60
1	973	9.67185	23	281	9.94587	7	208	9.72598	30	0.27402	794	59
2	999	9.67208	24	267	9.94580	7	246	9.72628	31	0.27372	781	58
3	47024	9.67232	24	254	9.94573	6	283	9.72659	30	0.27341	768	57
4	050	9.67256	24	240	9.94567	7	320	9.72689	31	0.27311	755	56
5	47076	9.67280	23	88226	9.94560	7	53358	9.72720	30	0.27280	1.8741	55
6	101	9.67303	24	213	9.94553	7	395	9.72750	30	0.27250	728	54
7	127	9.67327	23	199	9.94546	6	432	9.72780	31	0.27220	715	53
8	153	9.67350	24	185	9.94540	7	470	9.72811	30	0.27189	702	52
9	178	9.67374	24	172	9.94533	7	507	9.72841	31	0.27159	689	51
10	47204	9.67398	23	88158	9.94526	7	53545	9.72872	30	0.27128	1.8676	50
11	229	9.67421	24	144	9.94519	7	582	9.72902	30	0.27098	663	49
12	255	9.67445	23	130	9.94513	6	620	9.72932	30	0.27068	650	48
13	281	9.67468	24	117	9.94506	7	657	9.72963	31	0.27037	637	47
14	306	9.67492	23	103	9.94499	7	694	9.72993	30	0.27007	624	46
15	47332	9.67515	24	88089	9.94492	7	53732	9.73023	30	0.26977	1.8611	45
16	358	9.67539	23	075	9.94485	7	769	9.73054	31	0.26946	598	44
17	383	9.67562	24	062	9.94479	6	807	9.73084	30	0.26916	585	43
18	409	9.67586	23	048	9.94472	7	844	9.73114	30	0.26886	572	42
19	434	9.67609	24	034	9.94465	7	882	9.73144	30	0.26856	559	41
20	47460	9.67633	23	88020	9.94458	7	53920	9.73175	31	0.26825	1.8546	40
21	486	9.67656	24	006	9.94451	7	957	9.73205	30	0.26795	533	39
22	511	9.67680	23	87993	9.94445	6	995	9.73235	30	0.26765	520	38
23	537	9.67703	23	979	9.94438	7	54032	9.73265	30	0.26735	507	37
24	562	9.67726	24	965	9.94431	7	070	9.73295	30	0.26705	495	36
25	47588	9.67750	23	87951	9.94424	7	54107	9.73326	31	0.26674	1.8482	35
26	614	9.67773	23	937	9.94417	7	145	9.73356	30	0.26644	469	34
27	639	9.67796	24	923	9.94410	7	183	9.73386	30	0.26614	456	33
28	665	9.67820	23	909	9.94404	6	220	9.73416	30	0.26584	443	32
29	690	9.67843	23	896	9.94397	7	258	9.73446	30	0.26554	430	31
30	47716	9.67866	24	87882	9.94390	7	54296	9.73476	30	0.26524	1.8418	30
31	741	9.67890	23	868	9.94383	7	333	9.73507	31	0.26493	405	29
32	767	9.67913	23	854	9.94376	7	371	9.73537	30	0.26463	392	28
33	793	9.67936	23	840	9.94369	7	409	9.73567	30	0.26433	379	27
34	818	9.67959	23	826	9.94362	7	446	9.73597	30	0.26403	367	26
35	47844	9.67982	24	87812	9.94355	6	54484	9.73627	30	0.26373	1.8354	25
36	869	9.68006	23	798	9.94349	7	522	9.73657	30	0.26343	341	24
37	895	9.68029	23	784	9.94342	7	560	9.73687	30	0.26313	329	23
38	920	9.68052	23	770	9.94335	7	597	9.73717	30	0.26283	316	22
39	946	9.68075	23	756	9.94328	7	635	9.73747	30	0.26253	303	21
40	47971	9.68098	23	87743	9.94321	7	54673	9.73777	30	0.26223	1.8291	20
41	997	9.68121	23	729	9.94314	7	711	9.73807	30	0.26193	278	19
42	48022	9.68144	23	715	9.94307	7	748	9.73837	30	0.26163	265	18
43	048	9.68167	23	701	9.94300	7	786	9.73867	30	0.26133	253	17
44	073	9.68190	23	687	9.94293	7	824	9.73897	30	0.26103	240	16
45	48099	9.68213	24	87673	9.94286	7	54862	9.73927	30	0.26073	1.8228	15
46	124	9.68237	23	659	9.94279	6	900	9.73957	30	0.26043	215	14
47	150	9.68260	23	645	9.94273	7	938	9.73987	30	0.26013	202	13
48	175	9.68283	22	631	9.94266	7	975	9.74017	30	0.25983	190	12
49	201	9.68305	23	617	9.94259	7	55013	9.74047	30	0.25953	177	11
50	48226	9.68328	23	87603	9.94252	7	55051	9.74077	30	0.25923	1.8165	10
51	252	9.68351	23	589	9.94245	7	089	9.74107	30	0.25893	152	9
52	277	9.68374	23	575	9.94238	7	127	9.74137	29	0.25863	140	8
53	303	9.68397	23	561	9.94231	7	165	9.74166	30	0.25834	127	7
54	328	9.68420	23	546	9.94224	7	203	9.74196	30	0.25804	115	6
55	48354	9.68443	23	87532	9.94217	7	55241	9.74226	30	0.25774	1.8103	5
56	379	9.68466	23	518	9.94210	7	279	9.74256	30	0.25744	090	4
57	405	9.68489	23	504	9.94203	7	317	9.74286	30	0.25714	078	3
58	430	9.68512	22	490	9.94196	7	355	9.74316	29	0.25684	065	2
59	456	9.68534	23	476	9.94189	7	393	9.74345	30	0.25655	053	1
60	481	9.68557		462	9.94182		431	9.74375		0.25625	040	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	48481	9.68557	23	87462	9.94182	7	55431	9.74375	30	0.25625	1.8040	60
1	506	9.68580	23	448	9.94175	7	469	9.74405	30	0.25595	028	59
2	532	9.68603	22	434	9.94168	7	507	9.74435	30	0.25565	016	58
3	557	9.68625	23	420	9.94161	7	545	9.74465	29	0.25535	003	57
4	583	9.68648	23	406	9.94154	7	583	9.74494	30	0.25506	1.7991	56
5	48608	9.68671	23	87391	9.94147	7	55621	9.74524	30	0.25476	1.7979	55
6	634	9.68694	23	377	9.94140	7	659	9.74554	30	0.25446	966	54
7	659	9.68716	22	363	9.94133	7	697	9.74583	29	0.25417	954	53
8	684	9.68739	23	349	9.94126	7	736	9.74613	30	0.25387	942	52
9	710	9.68762	23	335	9.94119	7	774	9.74643	30	0.25357	930	51
10	48735	9.68784	22	87321	9.94112	7	55812	9.74673	30	0.25327	1.7917	50
11	761	9.68807	23	306	9.94105	7	850	9.74702	29	0.25298	905	49
12	786	9.68829	22	292	9.94098	7	888	9.74732	30	0.25268	893	48
13	811	9.68852	23	278	9.94090	8	926	9.74762	30	0.25238	881	47
14	837	9.68875	23	264	9.94083	7	964	9.74791	29	0.25209	868	46
15	48862	9.68897	22	87250	9.94076	7	56003	9.74821	30	0.25179	1.7856	45
16	888	9.68920	23	235	9.94069	7	041	9.74851	30	0.25149	844	44
17	913	9.68942	22	221	9.94062	7	079	9.74880	29	0.25120	832	43
18	938	9.68965	23	207	9.94055	7	117	9.74910	30	0.25090	820	42
19	964	9.68987	22	193	9.94048	7	156	9.74939	29	0.25061	808	41
20	48989	9.69010	23	87178	9.94041	7	56194	9.74969	30	0.25031	1.7796	40
21	49014	9.69032	22	164	9.94034	7	232	9.74998	29	0.25002	783	39
22	040	9.69055	23	150	9.94027	7	270	9.75028	30	0.24972	771	38
23	065	9.69077	22	136	9.94020	7	309	9.75058	30	0.24942	759	37
24	090	9.69100	23	121	9.94012	8	347	9.75087	29	0.24913	747	36
25	49116	9.69122	22	87107	9.94005	7	56385	9.75117	30	0.24883	1.7735	35
26	141	9.69144	22	093	9.93998	7	424	9.75146	29	0.24854	723	34
27	166	9.69167	23	079	9.93991	7	462	9.75176	30	0.24824	711	33
28	192	9.69189	22	064	9.93984	7	501	9.75205	29	0.24795	699	32
29	217	9.69212	23	050	9.93977	7	539	9.75235	30	0.24765	687	31
30	49242	9.69234	22	87036	9.93970	7	56577	9.75264	29	0.24736	1.7675	30
31	268	9.69256	22	021	9.93963	8	616	9.75294	30	0.24706	663	29
32	293	9.69279	23	007	9.93955	7	654	9.75323	29	0.24677	651	28
33	318	9.69301	22	86993	9.93948	7	693	9.75353	30	0.24647	639	27
34	344	9.69323	22	978	9.93941	7	731	9.75382	29	0.24618	627	26
35	49369	9.69345	22	86964	9.93934	7	56769	9.75411	29	0.24589	1.7615	25
36	394	9.69368	23	949	9.93927	7	808	9.75441	30	0.24559	603	24
37	419	9.69390	22	935	9.93920	8	846	9.75470	29	0.24530	591	23
38	445	9.69412	22	921	9.93912	7	885	9.75500	30	0.24500	579	22
39	470	9.69434	22	906	9.93905	7	923	9.75529	29	0.24471	567	21
40	49495	9.69456	22	86892	9.93898	7	56962	9.75558	29	0.24442	1.7556	20
41	521	9.69479	23	878	9.93891	7	57000	9.75588	30	0.24412	544	19
42	546	9.69501	22	863	9.93884	8	039	9.75617	29	0.24383	532	18
43	571	9.69523	22	849	9.93876	7	078	9.75647	30	0.24353	520	17
44	596	9.69545	22	834	9.93869	7	116	9.75676	29	0.24324	508	16
45	49622	9.69567	22	86820	9.93862	7	57155	9.75705	29	0.24295	1.7496	15
46	647	9.69589	22	805	9.93855	7	193	9.75735	30	0.24265	485	14
47	672	9.69611	22	791	9.93847	8	232	9.75764	29	0.24236	473	13
48	697	9.69633	22	777	9.93840	7	271	9.75793	29	0.24207	461	12
49	723	9.69655	22	762	9.93833	7	309	9.75822	29	0.24178	449	11
50	49748	9.69677	22	86748	9.93826	7	57348	9.75852	30	0.24148	1.7437	10
51	773	9.69699	22	733	9.93819	8	386	9.75881	29	0.24119	426	9
52	798	9.69721	22	719	9.93811	7	425	9.75910	29	0.24090	414	8
53	824	9.69743	22	704	9.93804	7	464	9.75939	29	0.24061	402	7
54	849	9.69765	22	690	9.93797	8	503	9.75969	30	0.24031	391	6
55	49874	9.69787	22	86675	9.93789	7	57541	9.75998	29	0.24002	1.7379	5
56	899	9.69809	22	661	9.93782	7	580	9.76027	29	0.23973	367	4
57	924	9.69831	22	646	9.93775	7	619	9.76056	29	0.23944	355	3
58	950	9.69853	22	632	9.93768	8	657	9.76086	30	0.23914	344	2
59	975	9.69875	22	617	9.93760	7	696	9.76115	29	0.23885	332	1
60	50000	9.69897	22	603	9.93753	7	735	9.76144	29	0.23856	321	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	50000	9.69897	22	86603	9.93753	7	57735	9.76144	29	0.23856	1.7321	60
1	025	9.69919	22	588	9.93746	8	774	9.76173	29	0.23827	309	59
2	050	9.69941	22	573	9.93738	7	813	9.76202	29	0.23798	297	58
3	076	9.69963	21	559	9.93731	7	851	9.76231	30	0.23769	286	57
4	101	9.69984	22	544	9.93724	7	890	9.76261	29	0.23739	274	56
5	50126	9.70006	22	86530	9.93717	8	57929	9.76290	29	0.23710	1.7262	55
6	151	9.70028	22	515	9.93709	7	968	9.76319	29	0.23681	251	54
7	176	9.70050	22	501	9.93702	7	58007	9.76348	29	0.23652	239	53
8	201	9.70072	21	486	9.93695	8	046	9.76377	29	0.23623	228	52
9	227	9.70093	22	471	9.93687	7	085	9.76406	29	0.23594	216	51
10	50252	9.70115	22	86457	9.93680	7	58124	9.76435	29	0.23565	1.7205	50
11	277	9.70137	22	442	9.93673	8	162	9.76464	29	0.23536	193	49
12	302	9.70159	21	427	9.93665	7	201	9.76493	29	0.23507	182	48
13	327	9.70180	22	413	9.93658	8	240	9.76522	29	0.23478	170	47
14	352	9.70202	22	398	9.93650	7	279	9.76551	29	0.23449	159	46
15	50377	9.70224	21	86384	9.93643	7	58318	9.76580	29	0.23420	1.7147	45
16	403	9.70245	22	369	9.93636	8	357	9.76609	30	0.23391	136	44
17	428	9.70267	21	354	9.93628	7	396	9.76639	29	0.23361	124	43
18	453	9.70288	22	340	9.93621	7	435	9.76668	29	0.23332	113	42
19	478	9.70310	22	325	9.93614	8	474	9.76697	28	0.23303	102	41
20	50503	9.70332	21	86310	9.93606	7	58513	9.76725	29	0.23275	1.7090	40
21	528	9.70353	22	295	9.93599	8	552	9.76754	29	0.23246	079	39
22	553	9.70375	21	281	9.93591	7	591	9.76783	29	0.23217	067	38
23	578	9.70396	22	266	9.93584	7	631	9.76812	29	0.23188	056	37
24	603	9.70418	21	251	9.93577	8	670	9.76841	29	0.23159	045	36
25	50628	9.70439	22	86237	9.93569	7	58709	9.76870	29	0.23130	1.7033	35
26	654	9.70461	21	222	9.93562	8	748	9.76899	29	0.23101	022	34
27	679	9.70482	22	207	9.93554	7	787	9.76928	29	0.23072	011	33
28	704	9.70504	21	192	9.93547	8	826	9.76957	29	0.23043	1.6999	32
29	729	9.70525	22	178	9.93539	7	865	9.76986	29	0.23014	988	31
30	50754	9.70547	21	86163	9.93532	7	58905	9.77015	29	0.22985	1.6977	30
31	779	9.70568	22	148	9.93525	8	944	9.77044	29	0.22956	965	29
32	804	9.70590	21	133	9.93517	7	983	9.77073	28	0.22927	954	28
33	829	9.70611	22	119	9.93510	8	59022	9.77101	29	0.22899	943	27
34	854	9.70633	21	104	9.93502	7	061	9.77130	29	0.22870	932	26
35	50879	9.70654	21	86089	9.93495	8	59101	9.77159	29	0.22841	1.6920	25
36	904	9.70675	22	074	9.93487	7	140	9.77188	29	0.22812	909	24
37	929	9.70697	21	059	9.93480	8	179	9.77217	29	0.22783	898	23
38	954	9.70718	21	045	9.93472	7	218	9.77246	28	0.22754	887	22
39	979	9.70739	22	030	9.93465	8	258	9.77274	29	0.22726	875	21
40	51004	9.70761	21	86015	9.93457	7	59297	9.77303	29	0.22697	1.6864	20
41	029	9.70782	21	000	9.93450	8	336	9.77332	29	0.22668	853	19
42	054	9.70803	21	85985	9.93442	7	376	9.77361	29	0.22639	842	18
43	079	9.70824	22	970	9.93435	8	415	9.77390	28	0.22610	831	17
44	104	9.70846	21	956	9.93427	7	454	9.77418	29	0.22582	820	16
45	51129	9.70867	21	85941	9.93420	8	59494	9.77447	29	0.22553	1.6808	15
46	154	9.70888	21	926	9.93412	7	533	9.77476	29	0.22524	797	14
47	179	9.70909	22	911	9.93405	8	573	9.77505	28	0.22495	786	13
48	204	9.70931	21	896	9.93397	7	612	9.77533	29	0.22467	775	12
49	229	9.70952	21	881	9.93390	8	651	9.77562	29	0.22438	764	11
50	51254	9.70973	21	85866	9.93382	7	59691	9.77591	28	0.22409	1.6753	10
51	279	9.70994	21	851	9.93375	8	730	9.77619	29	0.22381	742	9
52	304	9.71015	21	836	9.93367	7	770	9.77648	29	0.22352	731	8
53	329	9.71036	22	821	9.93360	8	809	9.77677	29	0.22323	720	7
54	354	9.71058	21	806	9.93352	8	849	9.77706	28	0.22294	709	6
55	51379	9.71079	21	85792	9.93344	7	59888	9.77734	29	0.22266	1.6698	5
56	404	9.71100	21	777	9.93337	8	928	9.77763	28	0.22237	687	4
57	429	9.71121	21	762	9.93329	7	967	9.77791	29	0.22209	676	3
58	454	9.71142	21	747	9.93322	8	60007	9.77820	29	0.22180	665	2
59	479	9.71163	21	732	9.93314	7	046	9.77849	28	0.22151	654	1
60	504	9.71184		717	9.93307		086	9.77877		0.22123	643	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	′
0	51504	9.71184	21	85717	9.93307	8	60086	9.77877	29	0.22123	1.6643	60
1	529	9.71205	21	702	9.93299	8	126	9.77906	29	0.22094	632	59
2	554	9.71226	21	687	9.93291	7	165	9.77935	28	0.22065	621	58
3	579	9.71247	21	672	9.93284	8	205	9.77963	29	0.22037	610	57
4	604	9.71268	21	657	9.93276	7	245	9.77992	28	0.22008	599	56
5	51628	9.71289	21	85642	9.93269	8	60284	9.78020	29	0.21980	1.6588	55
6	653	9.71310	21	627	9.93261	8	324	9.78049	28	0.21951	577	54
7	678	9.71331	21	612	9.93253	7	364	9.78077	29	0.21923	566	53
8	703	9.71352	21	597	9.93246	8	403	9.78106	29	0.21894	555	52
9	728	9.71373	20	582	9.93238	8	443	9.78135	28	0.21865	545	51
10	51753	9.71393	21	85567	9.93230	7	60483	9.78163	29	0.21837	1.6534	50
11	778	9.71414	21	551	9.93223	8	522	9.78192	28	0.21808	523	49
12	803	9.71435	21	536	9.93215	8	562	9.78220	29	0.21780	512	48
13	828	9.71456	21	521	9.93207	7	602	9.78249	28	0.21751	501	47
14	852	9.71477	21	506	9.93200	8	642	9.78277	29	0.21723	490	46
15	51877	9.71498	21	85491	9.93192	8	60681	9.78306	28	0.21694	1.6479	45
16	902	9.71519	20	476	9.93184	7	721	9.78334	29	0.21666	469	44
17	927	9.71539	21	461	9.93177	8	761	9.78363	28	0.21637	458	43
18	952	9.71560	21	446	9.93169	8	801	9.78391	28	0.21609	447	42
19	977	9.71581	21	431	9.93161	7	841	9.78419	29	0.21581	436	41
20	52002	9.71602	20	85416	9.93154	8	60881	9.78448	28	0.21552	1.6426	40
21	026	9.71622	21	401	9.93146	8	921	9.78476	29	0.21524	415	39
22	051	9.71643	21	385	9.93138	7	960	9.78505	28	0.21495	404	38
23	076	9.71664	21	370	9.93131	8	61000	9.78533	29	0.21467	393	37
24	101	9.71685	20	355	9.93123	8	040	9.78562	28	0.21438	383	36
25	52126	9.71705	21	85340	9.93115	7	61080	9.78590	28	0.21410	1.6372	35
26	151	9.71726	21	325	9.93108	8	120	9.78618	29	0.21382	361	34
27	175	9.71747	20	310	9.93100	8	160	9.78647	28	0.21353	351	33
28	200	9.71767	21	294	9.93092	8	200	9.78675	29	0.21325	340	32
29	225	9.71788	21	279	9.93084	7	240	9.78704	28	0.21296	329	31
30	52250	9.71809	20	85264	9.93077	8	61280	9.78732	28	0.21268	1.6319	30
31	275	9.71829	21	249	9.93069	8	320	9.78760	29	0.21240	308	29
32	299	9.71850	20	234	9.93061	8	360	9.78789	28	0.21211	297	28
33	324	9.71870	21	218	9.93053	7	400	9.78817	28	0.21183	287	27
34	349	9.71891	20	203	9.93046	8	440	9.78845	29	0.21155	276	26
35	52374	9.71911	21	85188	9.93038	8	61480	9.78874	28	0.21126	1.6265	25
36	399	9.71932	20	173	9.93030	8	520	9.78902	28	0.21098	255	24
37	423	9.71952	21	157	9.93022	8	561	9.78930	29	0.21070	244	23
38	448	9.71973	21	142	9.93014	7	601	9.78959	28	0.21041	234	22
39	473	9.71994	20	127	9.93007	8	641	9.78987	28	0.21013	223	21
40	52498	9.72014	20	85112	9.92999	8	61681	9.79015	28	0.20985	1.6212	20
41	522	9.72034	21	096	9.92991	8	721	9.79043	29	0.20957	202	19
42	547	9.72055	20	081	9.92983	7	761	9.79072	28	0.20928	191	18
43	572	9.72075	21	066	9.92976	8	801	9.79100	28	0.20900	181	17
44	597	9.72096	20	051	9.92968	8	842	9.79128	28	0.20872	170	16
45	52621	9.72116	21	85035	9.92960	8	61882	9.79156	29	0.20844	1.6160	15
46	646	9.72137	20	020	9.92952	8	922	9.79185	28	0.20815	149	14
47	671	9.72157	20	005	9.92944	8	962	9.79213	28	0.20787	139	13
48	696	9.72177	21	84989	9.92936	7	62003	9.79241	28	0.20759	128	12
49	720	9.72198	20	974	9.92929	8	043	9.79269	28	0.20731	118	11
50	52745	9.72218	20	84959	9.92921	8	62083	9.79297	29	0.20703	1.6107	10
51	770	9.72238	21	943	9.92913	8	124	9.79326	28	0.20674	097	9
52	794	9.72259	20	928	9.92905	8	164	9.79354	28	0.20646	087	8
53	819	9.72279	20	913	9.92897	8	204	9.79382	28	0.20618	076	7
54	844	9.72299	21	897	9.92889	8	245	9.79410	28	0.20590	066	6
55	52869	9.72320	20	84882	9.92881	7	62285	9.79438	28	0.20562	1.6055	5
56	893	9.72340	20	866	9.92874	8	325	9.79466	29	0.20534	045	4
57	918	9.72360	21	851	9.92866	8	366	9.79495	28	0.20505	034	3
58	943	9.72381	20	836	9.92858	8	406	9.79523	28	0.20477	024	2
59	967	9.72401	20	820	9.92850	8	446	9.79551	28	0.20449	014	1
60	992	9.72421	20	805	9.92842	8	487	9.79579	28	0.20421	003	0
′	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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32°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	52992	9.72421	20	84805	9.92842	8	62487	9.79579	28	0.20421	1.6003	60
1	53017	9.72441	20	789	9.92834	8	527	9.79607	28	0.20393	1.5993	59
2	041	9.72461	21	774	9.92826	8	568	9.79635	28	0.20365	983	58
3	066	9.72482	20	759	9.92818	8	608	9.79663	28	0.20337	972	57
4	091	9.72502	20	743	9.92810	7	649	9.79691	28	0.20309	962	56
5	53115	9.72522	20	84728	9.92803	8	62689	9.79719	28	0.20281	1.5952	55
6	140	9.72542	20	712	9.92795	8	730	9.79747	29	0.20253	941	54
7	164	9.72562	20	697	9.92787	8	770	9.79776	28	0.20224	931	53
8	189	9.72582	20	681	9.92779	8	811	9.79804	28	0.20196	921	52
9	214	9.72602	20	666	9.92771	8	852	9.79832	28	0.20168	911	51
10	53238	9.72622	21	84650	9.92763	8	62892	9.79860	28	0.20140	1.5900	50
11	263	9.72643	20	635	9.92755	8	933	9.79888	28	0.20112	890	49
12	288	9.72663	20	619	9.92747	8	973	9.79916	28	0.20084	880	48
13	312	9.72683	20	604	9.92739	8	63014	9.79944	28	0.20056	869	47
14	337	9.72703	20	588	9.92731	8	055	9.79972	28	0.20028	859	46
15	53361	9.72723	20	84573	9.92723	8	63095	9.80000	28	0.20000	1.5849	45
16	386	9.72743	20	557	9.92715	8	136	9.80028	28	0.19972	839	44
17	411	9.72763	20	542	9.92707	8	177	9.80056	28	0.19944	829	43
18	435	9.72783	20	526	9.92699	8	217	9.80084	28	0.19916	818	42
19	460	9.72803	20	511	9.92691	8	258	9.80112	28	0.19888	808	41
20	53484	9.72823	20	84495	9.92683	8	63299	9.80140	28	0.19860	1.5798	40
21	509	9.72843	20	480	9.92675	8	340	9.80168	27	0.19832	788	39
22	534	9.72863	20	464	9.92667	8	380	9.80195	28	0.19805	778	38
23	558	9.72883	19	448	9.92659	8	421	9.80223	28	0.19777	768	37
24	583	9.72902	20	433	9.92651	8	462	9.80251	28	0.19749	757	36
25	53607	9.72922	20	84417	9.92643	8	63503	9.80279	28	0.19721	1.5747	35
26	632	9.72942	20	402	9.92635	8	544	9.80307	28	0.19693	737	34
27	656	9.72962	20	386	9.92627	8	584	9.80335	28	0.19665	727	33
28	681	9.72982	20	370	9.92619	8	625	9.80363	28	0.19637	717	32
29	705	9.73002	20	355	9.92611	8	666	9.80391	28	0.19609	707	31
30	53730	9.73022	19	84339	9.92603	8	63707	9.80419	28	0.19581	1.5697	30
31	754	9.73041	20	324	9.92595	8	748	9.80447	27	0.19553	687	29
32	779	9.73061	20	308	9.92587	8	789	9.80474	28	0.19526	677	28
33	804	9.73081	20	292	9.92579	8	830	9.80502	28	0.19498	667	27
34	828	9.73101	20	277	9.92571	8	871	9.80530	28	0.19470	657	26
35	53853	9.73121	19	84261	9.92563	8	63912	9.80558	28	0.19442	1.5647	25
36	877	9.73140	20	245	9.92555	9	953	9.80586	28	0.19414	637	24
37	902	9.73160	20	230	9.92546	8	994	9.80614	28	0.19386	627	23
38	926	9.73180	20	214	9.92538	8	64035	9.80642	27	0.19358	617	22
39	951	9.73200	19	198	9.92530	8	076	9.80669	28	0.19331	607	21
40	53975	9.73219	20	84182	9.92522	8	64117	9.80697	28	0.19303	1.5597	20
41	54000	9.73239	20	167	9.92514	8	158	9.80725	28	0.19275	587	19
42	024	9.73259	19	151	9.92506	8	199	9.80753	28	0.19247	577	18
43	049	9.73278	20	135	9.92498	8	240	9.80781	27	0.19219	567	17
44	073	9.73298	20	120	9.92490	8	281	9.80808	28	0.19192	557	16
45	54097	9.73318	19	84104	9.92482	9	64322	9.80836	28	0.19164	1.5547	15
46	122	9.73337	20	088	9.92473	8	363	9.80864	28	0.19136	537	14
47	146	9.73357	20	072	9.92465	8	404	9.80892	27	0.19108	527	13
48	171	9.73377	19	057	9.92457	8	446	9.80919	28	0.19081	517	12
49	195	9.73396	20	041	9.92449	8	487	9.80947	28	0.19053	507	11
50	54220	9.73416	19	84025	9.92441	8	64528	9.80975	28	0.19025	1.5497	10
51	244	9.73435	20	009	9.92433	8	569	9.81003	27	0.18997	487	9
52	269	9.73455	19	83994	9.92425	9	610	9.81030	28	0.18970	477	8
53	293	9.73474	20	978	9.92416	8	652	9.81058	28	0.18942	468	7
54	317	9.73494	19	962	9.92408	8	693	9.81086	27	0.18914	458	6
55	54342	9.73513	20	83946	9.92400	8	64734	9.81113	28	0.18887	1.5448	5
56	366	9.73533	19	930	9.92392	8	775	9.81141	28	0.18859	438	4
57	391	9.73552	20	915	9.92384	8	817	9.81169	27	0.18831	428	3
58	415	9.73572	19	899	9.92376	9	858	9.81196	28	0.18804	418	2
59	440	9.73591	20	883	9.92367	8	899	9.81224	28	0.18776	408	1
60	464	9.73611		867	9.92359		941	9.81252		0.18748	399	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	′
0	54464	9.73611	19	83867	9.92359	8	64941	9.81252	27	0.18748	1.5399	60
1	488	9.73630	20	851	9.92351	8	982	9.81279	28	0.18721	389	59
2	513	9.73650	19	835	9.92343	8	65024	9.81307	28	0.18693	379	58
3	537	9.73669	20	819	9.92335	9	065	9.81335	27	0.18665	369	57
4	561	9.73689	19	804	9.92326	8	106	9.81362	28	0.18638	359	56
5	54586	9.73708	19	83788	9.92318	8	65148	9.81390	28	0.18610	1.5350	55
6	610	9.73727	20	772	9.92310	8	189	9.81418	27	0.18582	340	54
7	635	9.73747	19	756	9.92302	8	231	9.81445	28	0.18555	330	53
8	659	9.73766	19	740	9.92293	9	272	9.81473	27	0.18527	320	52
9	683	9.73785	20	724	9.92285	8	314	9.81500	28	0.18500	311	51
10	54708	9.73805	19	83708	9.92277	8	65355	9.81528	28	0.18472	1.5301	50
11	732	9.73824	19	692	9.92269	8	397	9.81556	27	0.18444	291	49
12	756	9.73843	20	676	9.92260	9	438	9.81583	28	0.18417	282	48
13	781	9.73863	19	660	9.92252	8	480	9.81611	27	0.18389	272	47
14	805	9.73882	19	645	9.92244	8	521	9.81638	28	0.18362	262	46
15	54829	9.73901	20	83629	9.92235	9	65563	9.81666	28	0.18334	1.5253	45
16	854	9.73921	19	613	9.92227	8	604	9.81693	27	0.18307	243	44
17	878	9.73940	19	597	9.92219	8	646	9.81721	28	0.18279	233	43
18	902	9.73959	19	581	9.92211	8	688	9.81748	27	0.18252	224	42
19	927	9.73978	19	565	9.92202	9	729	9.81776	28	0.18224	214	41
20	54951	9.73997	19	83549	9.92194	8	65771	9.81803	27	0.18197	1.5204	40
21	975	9.74017	20	533	9.92186	8	813	9.81831	28	0.18169	195	39
22	999	9.74036	19	517	9.92177	9	854	9.81858	27	0.18142	185	38
23	55024	9.74055	19	501	9.92169	8	896	9.81886	28	0.18114	175	37
24	048	9.74074	19	485	9.92161	8	938	9.81913	27	0.18087	166	36
25	55072	9.74093	19	83469	9.92152	9	65980	9.81941	28	0.18059	1.5156	35
26	097	9.74113	20	453	9.92144	8	66021	9.81968	27	0.18032	147	34
27	121	9.74132	19	437	9.92136	8	063	9.81996	28	0.18004	137	33
28	145	9.74151	19	421	9.92127	9	105	9.82023	27	0.17977	127	32
29	169	9.74170	19	405	9.92119	8	147	9.82051	28	0.17949	118	31
30	55194	9.74189	19	83389	9.92111	8	66189	9.82078	27	0.17922	1.5108	30
31	218	9.74208	19	373	9.92102	9	230	9.82106	28	0.17894	099	29
32	242	9.74227	19	356	9.92094	8	272	9.82133	27	0.17867	089	28
33	266	9.74246	19	340	9.92086	8	314	9.82161	28	0.17839	080	27
34	291	9.74265	19	324	9.92077	9	356	9.82188	27	0.17812	070	26
35	55315	9.74284	19	83308	9.92069	8	66398	9.82215	27	0.17785	1.5061	25
36	339	9.74303	19	292	9.92060	8	440	9.82243	28	0.17757	051	24
37	363	9.74322	19	276	9.92052	8	482	9.82270	27	0.17730	042	23
38	388	9.74341	19	260	9.92044	9	524	9.82298	28	0.17702	032	22
39	412	9.74360	19	244	9.92035	8	566	9.82325	27	0.17675	023	21
40	55436	9.74379	19	83228	9.92027	9	66608	9.82352	27	0.17648	1.5013	20
41	460	9.74398	19	212	9.92018	8	650	9.82380	28	0.17620	004	19
42	484	9.74417	19	195	9.92010	8	692	9.82407	27	0.17593	1.4994	18
43	509	9.74436	19	179	9.92002	9	734	9.82435	28	0.17565	985	17
44	533	9.74455	19	163	9.91993	8	776	9.82462	27	0.17538	975	16
45	55557	9.74474	19	83147	9.91985	8	66818	9.82489	28	0.17511	1.4966	15
46	581	9.74493	19	131	9.91976	9	860	9.82517	27	0.17483	957	14
47	605	9.74512	19	115	9.91968	8	902	9.82544	27	0.17456	947	13
48	630	9.74531	18	098	9.91959	8	944	9.82571	28	0.17429	938	12
49	654	9.74549	19	082	9.91951	9	986	9.82599	27	0.17401	928	11
50	55678	9.74568	19	83066	9.91942	8	67028	9.82626	27	0.17374	1.4919	10
51	702	9.74587	19	050	9.91934	9	071	9.82653	28	0.17347	910	9
52	726	9.74606	19	034	9.91925	8	113	9.82681	27	0.17319	900	8
53	750	9.74625	19	017	9.91917	9	155	9.82708	27	0.17292	891	7
54	775	9.74644	18	001	9.91908	8	197	9.82735	27	0.17265	882	6
55	55799	9.74662	19	82985	9.91900	8	67239	9.82762	28	0.17238	1.4872	5
56	823	9.74681	19	969	9.91891	9	282	9.82790	27	0.17210	863	4
57	847	9.74700	19	953	9.91883	8	324	9.82817	27	0.17183	854	3
58	871	9.74719	18	936	9.91874	9	366	9.82844	27	0.17156	844	2
59	895	9.74737	19	920	9.91866	8	409	9.82871	28	0.17129	835	1
60	919	9.74756	19	904	9.91857	9	451	9.82899	28	0.17101	826	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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34°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	′
0	55919	9.74756	19	82904	9.91857	8	67451	9.82899	27	0.17101	1.4826	60
1	943	9.74775	19	887	9.91849	9	493	9.82926	27	0.17074	816	59
2	968	9.74794	18	871	9.91840	8	536	9.82953	27	0.17047	807	58
3	992	9.74812	19	855	9.91832	9	578	9.82980	28	0.17020	798	57
4	56016	9.74831	19	839	9.91823	8	620	9.83008	27	0.16992	788	56
5	56040	9.74850	18	82822	9.91815	9	67663	9.83035	27	0.16965	1.4779	55
6	064	9.74868	19	806	9.91806	8	705	9.83062	27	0.16938	770	54
7	088	9.74887	19	790	9.91798	9	748	9.83089	28	0.16911	761	53
8	112	9.74906	18	773	9.91789	8	790	9.83117	27	0.16883	751	52
9	136	9.74924	19	757	9.91781	9	832	9.83144	27	0.16856	742	51
10	56160	9.74943	18	82741	9.91772	9	67875	9.83171	27	0.16829	1.4733	50
11	184	9.74961	19	724	9.91763	8	917	9.83198	27	0.16802	724	49
12	208	9.74980	19	708	9.91755	9	960	9.83225	27	0.16775	715	48
13	232	9.74999	18	692	9.91746	8	68002	9.83252	28	0.16748	705	47
14	256	9.75017	19	675	9.91738	9	045	9.83280	27	0.16720	696	46
15	56280	9.75036	18	82659	9.91729	9	68088	9.83307	27	0.16693	1.4687	45
16	305	9.75054	19	643	9.91720	8	130	9.83334	27	0.16666	678	44
17	329	9.75073	18	626	9.91712	9	173	9.83361	27	0.16639	669	43
18	353	9.75091	19	610	9.91703	8	215	9.83388	27	0.16612	659	42
19	377	9.75110	18	593	9.91695	9	258	9.83415	27	0.16585	650	41
20	56401	9.75128	19	82577	9.91686	9	68301	9.83442	28	0.16558	1.4641	40
21	425	9.75147	18	561	9.91677	8	343	9.83470	27	0.16530	632	39
22	449	9.75165	19	544	9.91669	9	386	9.83497	27	0.16503	623	38
23	473	9.75184	18	528	9.91660	9	429	9.83524	27	0.16476	614	37
24	497	9.75202	19	511	9.91651	8	471	9.83551	27	0.16449	605	36
25	56521	9.75221	18	82495	9.91643	9	68514	9.83578	27	0.16422	1.4596	35
26	545	9.75239	19	478	9.91634	9	557	9.83605	27	0.16395	586	34
27	569	9.75258	18	462	9.91625	8	600	9.83632	27	0.16368	577	33
28	593	9.75276	18	446	9.91617	9	642	9.83659	27	0.16341	568	32
29	617	9.75294	19	429	9.91608	9	685	9.83686	27	0.16314	559	31
30	56641	9.75313	18	82413	9.91599	8	68728	9.83713	27	0.16287	1.4550	30
31	665	9.75331	19	396	9.91591	9	771	9.83740	28	0.16260	541	29
32	689	9.75350	18	380	9.91582	9	814	9.83768	27	0.16232	532	28
33	713	9.75368	18	363	9.91573	8	857	9.83795	27	0.16205	523	27
34	736	9.75386	19	347	9.91565	9	900	9.83822	27	0.16178	514	26
35	56760	9.75405	18	82330	9.91556	9	68942	9.83849	27	0.16151	1.4505	25
36	784	9.75423	18	314	9.91547	9	985	9.83876	27	0.16124	496	24
37	808	9.75441	18	297	9.91538	8	69028	9.83903	27	0.16097	487	23
38	832	9.75459	19	281	9.91530	9	071	9.83930	27	0.16070	478	22
39	856	9.75478	18	264	9.91521	9	114	9.83957	27	0.16043	469	21
40	56880	9.75496	18	82248	9.91512	9	69157	9.83984	27	0.16016	1.4460	20
41	904	9.75514	19	231	9.91504	8	200	9.84011	27	0.15989	451	19
42	928	9.75533	18	214	9.91495	9	243	9.84038	27	0.15962	442	18
43	952	9.75551	18	198	9.91486	9	286	9.84065	27	0.15935	433	17
44	976	9.75569	18	181	9.91477	9	329	9.84092	27	0.15908	424	16
45	57000	9.75587	18	82165	9.91469	8	69372	9.84119	27	0.15881	1.4415	15
46	024	9.75605	19	148	9.91460	9	416	9.84146	27	0.15854	406	14
47	047	9.75624	18	132	9.91451	9	459	9.84173	27	0.15827	397	13
48	071	9.75642	18	115	9.91442	9	502	9.84200	27	0.15800	388	12
49	095	9.75660	18	098	9.91433	9	545	9.84227	27	0.15773	379	11
50	57119	9.75678	18	82082	9.91425	9	69588	9.84254	26	0.15746	1.4370	10
51	143	9.75696	18	065	9.91416	9	631	9.84280	27	0.15720	361	9
52	167	9.75714	19	048	9.91407	9	675	9.84307	27	0.15693	352	8
53	191	9.75733	18	032	9.91398	9	718	9.84334	27	0.15666	344	7
54	215	9.75751	18	015	9.91389	9	761	9.84361	27	0.15639	335	6
55	57238	9.75769	18	81999	9.91381	8	69804	9.84388	27	0.15612	1.4326	5
56	262	9.75787	18	982	9.91372	9	847	9.84415	27	0.15585	317	4
57	286	9.75805	18	965	9.91363	9	891	9.84442	27	0.15558	308	3
58	310	9.75823	18	949	9.91354	9	934	9.84469	27	0.15531	299	2
59	334	9.75841	18	932	9.91345	9	977	9.84496	27	0.15504	290	1
60	358	9.75859		915	9.91336		70021	9.84523		0.15477	281	0
′	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

55°

35°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	57358	9.75859	18	81915	9.91336	8	70021	9.84523	27	0.15477	1.4281	60
1	381	9.75877	18	899	9.91328	9	064	9.84550	26	0.15450	273	59
2	405	9.75895	18	882	9.91319	9	107	9.84576	27	0.15424	264	58
3	429	9.75913	18	865	9.91310	9	151	9.84603	27	0.15397	255	57
4	453	9.75931	18	848	9.91301	9	194	9.84630	27	0.15370	246	56
5	57477	9.75949	18	81832	9.91292	9	70238	9.84657	27	0.15343	1.4237	55
6	501	9.75967	18	815	9.91283	9	281	9.84684	27	0.15316	229	54
7	524	9.75985	18	798	9.91274	8	325	9.84711	27	0.15289	220	53
8	548	9.76003	18	782	9.91266	9	368	9.84738	27	0.15262	211	52
9	572	9.76021	18	765	9.91257	9	412	9.84764	26	0.15236	202	51
10	57596	9.76039	18	81748	9.91248	9	70455	9.84791	27	0.15209	1.4193	50
11	619	9.76057	18	731	9.91239	9	499	9.84818	27	0.15182	185	49
12	643	9.76075	18	714	9.91230	9	542	9.84845	27	0.15155	176	48
13	667	9.76093	18	698	9.91221	9	586	9.84872	27	0.15128	167	47
14	691	9.76111	18	681	9.91212	9	629	9.84899	26	0.15101	158	46
15	57715	9.76129	17	81664	9.91203	9	70673	9.84925	27	0.15075	1.4150	45
16	738	9.76146	18	647	9.91194	9	717	9.84952	27	0.15048	141	44
17	762	9.76164	18	631	9.91185	9	760	9.84979	27	0.15021	132	43
18	786	9.76182	18	614	9.91176	9	804	9.85006	27	0.14994	124	42
19	810	9.76200	18	597	9.91167	9	848	9.85033	26	0.14967	115	41
20	57833	9.76218	18	81580	9.91158	9	70891	9.85059	27	0.14941	1.4106	40
21	857	9.76236	17	563	9.91149	9	935	9.85086	27	0.14914	097	39
22	881	9.76253	18	546	9.91141	8	979	9.85113	27	0.14887	089	38
23	904	9.76271	18	530	9.91132	9	71023	9.85140	27	0.14860	080	37
24	928	9.76289	18	513	9.91123	9	066	9.85166	26	0.14834	071	36
25	57952	9.76307	17	81496	9.91114	9	71110	9.85193	27	0.14807	1.4063	35
26	976	9.76324	18	479	9.91105	9	154	9.85220	27	0.14780	054	34
27	999	9.76342	18	462	9.91096	9	198	9.85247	27	0.14753	045	33
28	58023	9.76360	18	445	9.91087	9	242	9.85273	26	0.14727	037	32
29	047	9.76378	17	428	9.91078	9	285	9.85300	27	0.14700	028	31
30	58070	9.76395	18	81412	9.91069	9	71329	9.85327	27	0.14673	1.4019	30
31	094	9.76413	18	395	9.91060	9	373	9.85354	26	0.14646	011	29
32	118	9.76431	17	378	9.91051	9	417	9.85380	27	0.14620	002	28
33	141	9.76448	18	361	9.91042	9	461	9.85407	27	0.14593	1.3994	27
34	165	9.76466	18	344	9.91033	10	505	9.85434	26	0.14566	985	26
35	58189	9.76484	17	81327	9.91023	9	71549	9.85460	27	0.14540	1.3976	25
36	212	9.76501	18	310	9.91014	9	593	9.85487	27	0.14513	968	24
37	236	9.76519	18	293	9.91005	9	637	9.85514	26	0.14486	959	23
38	260	9.76537	17	276	9.90996	9	681	9.85540	27	0.14460	951	22
39	283	9.76554	18	259	9.90987	9	725	9.85567	27	0.14433	942	21
40	58307	9.76572	18	81242	9.90978	9	71769	9.85594	26	0.14406	1.3934	20
41	330	9.76590	17	225	9.90969	9	813	9.85620	27	0.14380	925	19
42	354	9.76607	18	208	9.90960	9	857	9.85647	27	0.14353	916	18
43	378	9.76625	17	191	9.90951	9	901	9.85674	26	0.14326	908	17
44	401	9.76642	18	174	9.90942	9	946	9.85700	27	0.14300	899	16
45	58425	9.76660	17	81157	9.90933	9	71990	9.85727	27	0.14273	1.3891	15
46	449	9.76677	18	140	9.90924	9	72034	9.85754	26	0.14246	882	14
47	472	9.76695	17	123	9.90915	9	078	9.85780	27	0.14220	874	13
48	496	9.76712	18	106	9.90906	10	122	9.85807	27	0.14193	865	12
49	519	9.76730	17	089	9.90896	9	167	9.85834	26	0.14166	857	11
50	58543	9.76747	18	81072	9.90887	9	72211	9.85860	27	0.14140	1.3848	10
51	567	9.76765	17	055	9.90878	9	255	9.85887	26	0.14113	840	9
52	590	9.76782	18	038	9.90869	9	299	9.85913	27	0.14087	831	8
53	614	9.76800	17	021	9.90860	9	344	9.85940	27	0.14060	823	7
54	637	9.76817	18	004	9.90851	9	388	9.85967	26	0.14033	814	6
55	58661	9.76835	17	80987	9.90842	10	72432	9.85993	27	0.14007	1.3806	5
56	684	9.76852	18	970	9.90832	9	477	9.86020	26	0.13980	798	4
57	708	9.76870	17	953	9.90823	9	521	9.86046	27	0.13954	789	3
58	731	9.76887	17	936	9.90814	9	565	9.86073	27	0.13927	781	2
59	755	9.76904	18	919	9.90805	9	610	9.86100	26	0.13900	772	1
60	779	9.76922		902	9.90796		654	9.86126		0.13874	764	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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36°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	′
0	58779	9.76922	17	80902	9.90796	9	72654	9.86126	27	0.13874	1.3764	60
1	802	9.76939	18	885	9.90787	10	699	9.86153	26	0.13847	755	59
2	826	9.76957	17	867	9.90777	9	743	9.86179	27	0.13821	747	58
3	849	9.76974	17	850	9.90768	9	788	9.86206	26	0.13794	739	57
4	873	9.76991	18	833	9.90759	9	832	9.86232	27	0.13768	730	56
5	58896	9.77009	17	80816	9.90750	9	72877	9.86259	26	0.13741	1.3722	55
6	920	9.77026	17	799	9.90741	10	921	9.86285	27	0.13715	713	54
7	943	9.77043	18	782	9.90731	9	966	9.86312	26	0.13688	705	53
8	967	9.77061	17	765	9.90722	9	73010	9.86338	27	0.13662	697	52
9	990	9.77078	17	748	9.90713	9	055	9.86365	27	0.13635	688	51
10	59014	9.77095	17	80730	9.90704	10	73100	9.86392	26	0.13608	1.3680	50
11	037	9.77112	18	713	9.90694	9	144	9.86418	26	0.13582	672	49
12	061	9.77130	17	696	9.90685	9	189	9.86445	27	0.13555	663	48
13	084	9.77147	17	679	9.90676	9	234	9.86471	26	0.13529	655	47
14	108	9.77164	17	662	9.90667	10	278	9.86498	27	0.13502	647	46
15	59131	9.77181	18	80644	9.90657	9	73323	9.86524	26	0.13476	1.3638	45
16	154	9.77199	17	627	9.90648	9	368	9.86551	27	0.13449	630	44
17	178	9.77216	17	610	9.90639	9	413	9.86577	26	0.13423	622	43
18	201	9.77233	17	593	9.90630	10	457	9.86603	26	0.13397	613	42
19	225	9.77250	18	576	9.90620	9	502	9.86630	27	0.13370	605	41
20	59248	9.77268	17	80558	9.90611	9	73547	9.86656	26	0.13344	1.3597	40
21	272	9.77285	17	541	9.90602	10	592	9.86683	27	0.13317	588	39
22	295	9.77302	17	524	9.90592	9	637	9.86709	26	0.13291	580	38
23	318	9.77319	17	507	9.90583	9	681	9.86736	27	0.13264	572	37
24	342	9.77336	17	489	9.90574	9	726	9.86762	26	0.13238	564	36
25	59365	9.77353	17	80472	9.90565	10	73771	9.86789	27	0.13211	1.3555	35
26	389	9.77370	17	455	9.90555	9	816	9.86815	26	0.13185	547	34
27	412	9.77387	18	438	9.90546	9	861	9.86842	27	0.13158	539	33
28	436	9.77405	17	420	9.90537	10	906	9.86868	26	0.13132	531	32
29	459	9.77422	17	403	9.90527	9	951	9.86894	26	0.13106	522	31
30	59482	9.77439	17	80386	9.90518	9	73996	9.86921	27	0.13079	1.3514	30
31	506	9.77456	17	368	9.90509	10	74041	9.86947	26	0.13053	506	29
32	529	9.77473	17	351	9.90499	9	086	9.86974	27	0.13026	498	28
33	552	9.77490	17	334	9.90490	10	131	9.87000	26	0.13000	490	27
34	576	9.77507	17	316	9.90480	9	176	9.87027	27	0.12973	481	26
35	59599	9.77524	17	80299	9.90471	9	74221	9.87053	26	0.12947	1.3473	25
36	622	9.77541	17	282	9.90462	10	267	9.87079	26	0.12921	465	24
37	646	9.77558	17	264	9.90452	9	312	9.87106	27	0.12894	457	23
38	669	9.77575	17	247	9.90443	9	357	9.87132	26	0.12868	449	22
39	693	9.77592	17	230	9.90434	9	402	9.87158	26	0.12842	440	21
40	59716	9.77609	17	80212	9.90424	10	74447	9.87185	27	0.12815	1.3432	20
41	739	9.77626	17	195	9.90415	9	492	9.87211	26	0.12789	424	19
42	763	9.77643	17	178	9.90405	10	538	9.87238	27	0.12762	416	18
43	786	9.77660	17	160	9.90396	9	583	9.87264	26	0.12736	408	17
44	809	9.77677	17	143	9.90386	10	628	9.87290	26	0.12710	400	16
45	59832	9.77694	17	80125	9.90377	9	74674	9.87317	27	0.12683	1.3392	15
46	856	9.77711	17	108	9.90368	9	719	9.87343	26	0.12657	384	14
47	879	9.77728	16	091	9.90358	10	764	9.87369	26	0.12631	375	13
48	902	9.77744	17	073	9.90349	9	810	9.87396	27	0.12604	367	12
49	926	9.77761	17	056	9.90339	10	855	9.87422	26	0.12578	359	11
50	59949	9.77778	17	80038	9.90330	9	74900	9.87448	26	0.12552	1.3351	10
51	972	9.77795	17	021	9.90320	10	946	9.87475	27	0.12525	343	9
52	995	9.77812	17	003	9.90311	9	991	9.87501	26	0.12499	335	8
53	60019	9.77829	17	79986	9.90301	10	75037	9.87527	26	0.12473	327	7
54	042	9.77846	16	968	9.90292	9	082	9.87554	27	0.12446	319	6
55	60065	9.77862	17	79951	9.90282	10	75128	9.87580	26	0.12420	1.3311	5
56	089	9.77879	17	934	9.90273	9	173	9.87606	26	0.12394	303	4
57	112	9.77896	17	916	9.90263	10	219	9.87633	27	0.12367	295	3
58	135	9.77913	17	899	9.90254	9	264	9.87659	26	0.12341	287	2
59	158	9.77930	16	881	9.90244	10	310	9.87685	26	0.12315	278	1
60	182	9.77946		864	9.90235	9	355	9.87711	26	0.12289	270	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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37°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	60182	9.77946	17	79864	9.90235	10	75355	9.87711	27	0.12289	1.3270	60
1	205	9.77963	17	846	9.90225	9	401	9.87738	26	0.12262	262	59
2	228	9.77980	17	829	9.90216	10	447	9.87764	26	0.12236	254	58
3	251	9.77997	16	811	9.90206	9	492	9.87790	27	0.12210	246	57
4	274	9.78013	17	793	9.90197	10	538	9.87817	26	0.12183	238	56
5	60298	9.78030	17	79776	9.90187	9	75584	9.87843	26	0.12157	1.3230	55
6	321	9.78047	16	758	9.90178	10	629	9.87869	26	0.12131	222	54
7	344	9.78063	17	741	9.90168	9	675	9.87895	27	0.12105	214	53
8	367	9.78080	17	723	9.90159	10	721	9.87922	26	0.12078	206	52
9	390	9.78097	16	706	9.90149	10	767	9.87948	26	0.12052	198	51
10	60414	9.78113	17	79688	9.90139	9	75812	9.87974	26	0.12026	1.3190	50
11	437	9.78130	17	671	9.90130	10	858	9.88000	26	0.12000	182	49
12	460	9.78147	16	653	9.90120	9	904	9.88027	27	0.11973	175	48
13	483	9.78163	17	635	9.90111	10	950	9.88053	26	0.11947	167	47
14	506	9.78180	17	618	9.90101	10	996	9.88079	26	0.11921	159	46
15	60529	9.78197	16	79600	9.90091	9	76042	9.88105	26	0.11895	1.3151	45
16	553	9.78213	17	583	9.90082	10	088	9.88131	27	0.11869	143	44
17	576	9.78230	16	565	9.90072	9	134	9.88158	26	0.11842	135	43
18	599	9.78246	17	547	9.90063	10	180	9.88184	26	0.11816	127	42
19	622	9.78263	17	530	9.90053	10	226	9.88210	26	0.11790	119	41
20	60645	9.78280	16	79512	9.90043	9	76272	9.88236	26	0.11764	1.3111	40
21	668	9.78296	17	494	9.90034	10	318	9.88262	27	0.11738	103	39
22	691	9.78313	16	477	9.90024	10	364	9.88289	26	0.11711	095	38
23	714	9.78329	17	459	9.90014	9	410	9.88315	26	0.11685	087	37
24	738	9.78346	16	441	9.90005	10	456	9.88341	26	0.11659	079	36
25	60761	9.78362	17	79424	9.89995	10	76502	9.88367	26	0.11633	1.3072	35
26	784	9.78379	16	406	9.89985	9	548	9.88393	27	0.11607	064	34
27	807	9.78395	17	388	9.89976	10	594	9.88420	26	0.11580	056	33
28	830	9.78412	16	371	9.89966	10	640	9.88446	26	0.11554	048	32
29	853	9.78428	17	353	9.89956	9	686	9.88472	26	0.11528	040	31
30	60876	9.78445	16	79335	9.89947	10	76733	9.88498	26	0.11502	1.3032	30
31	899	9.78461	17	318	9.89937	10	779	9.88524	26	0.11476	024	29
32	922	9.78478	16	300	9.89927	9	825	9.88550	27	0.11450	017	28
33	945	9.78494	16	282	9.89918	10	871	9.88577	26	0.11423	009	27
34	968	9.78510	17	264	9.89908	10	918	9.88603	26	0.11397	001	26
35	60991	9.78527	16	79247	9.89898	10	76964	9.88629	26	0.11371	1.2993	25
36	61015	9.78543	17	229	9.89888	9	77010	9.88655	26	0.11345	985	24
37	038	9.78560	16	211	9.89879	10	057	9.88681	26	0.11319	977	23
38	061	9.78576	16	193	9.89869	10	103	9.88707	26	0.11293	970	22
39	084	9.78592	17	176	9.89859	10	149	9.88733	26	0.11267	962	21
40	61107	9.78609	16	79158	9.89849	9	77196	9.88759	27	0.11241	1.2954	20
41	130	9.78625	17	140	9.89840	10	242	9.88786	26	0.11214	946	19
42	153	9.78642	16	122	9.89830	10	289	9.88812	26	0.11188	938	18
43	176	9.78658	16	105	9.89820	10	335	9.88838	26	0.11162	931	17
44	199	9.78674	17	087	9.89810	9	382	9.88864	26	0.11136	923	16
45	61222	9.78691	16	79069	9.89801	10	77428	9.88890	26	0.11110	1.2915	15
46	245	9.78707	16	051	9.89791	10	475	9.88916	26	0.11084	907	14
47	268	9.78723	16	033	9.89781	10	521	9.88942	26	0.11058	900	13
48	291	9.78739	17	016	9.89771	10	568	9.88968	26	0.11032	892	12
49	314	9.78756	16	78998	9.89761	9	615	9.88994	26	0.11006	884	11
50	61337	9.78772	16	78980	9.89752	10	77661	9.89020	26	0.10980	1.2876	10
51	360	9.78788	17	962	9.89742	10	708	9.89046	27	0.10954	869	9
52	383	9.78805	16	944	9.89732	10	754	9.89073	26	0.10927	861	8
53	406	9.78821	16	926	9.89722	10	801	9.89099	26	0.10901	853	7
54	429	9.78837	16	908	9.89712	10	848	9.89125	26	0.10875	846	6
55	61451	9.78853	16	78891	9.89702	9	77895	9.89151	26	0.10849	1.2838	5
56	474	9.78869	17	873	9.89693	10	941	9.89177	26	0.10823	830	4
57	497	9.78886	16	855	9.89683	10	988	9.89203	26	0.10797	822	3
58	520	9.78902	16	837	9.89673	10	78035	9.89229	26	0.10771	815	2
59	543	9.78918	16	819	9.89663	10	082	9.89255	26	0.10745	807	1
60	566	9.78934		801	9.89653		129	9.89281		0.10719	799	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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38°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	61566	9.78934	16	78801	9.89653	10	78129	9.89281	26	0.10719	1.2799	60
1	589	9.78950	17	783	9.89643	10	175	9.89307	26	0.10693	792	59
2	612	9.78967	16	765	9.89633	9	222	9.89333	26	0.10667	784	58
3	635	9.78983	16	747	9.89624	10	269	9.89359	26	0.10641	776	57
4	658	9.78999	16	729	9.89614	10	316	9.89385	26	0.10615	769	56
5	61681	9.79015	16	78711	9.89604	10	78363	9.89411	26	0.10589	1.2761	55
6	704	9.79031	16	694	9.89594	10	410	9.89437	26	0.10563	753	54
7	726	9.79047	16	676	9.89584	10	457	9.89463	26	0.10537	746	53
8	749	9.79063	16	658	9.89574	10	504	9.89489	26	0.10511	738	52
9	772	9.79079	16	640	9.89564	10	551	9.89515	26	0.10485	731	51
10	61795	9.79095	16	78622	9.89554	10	78598	9.89541	26	0.10459	1.2723	50
11	818	9.79111	17	604	9.89544	10	645	9.89567	26	0.10433	715	49
12	841	9.79128	16	586	9.89534	10	692	9.89593	26	0.10407	708	48
13	864	9.79144	16	568	9.89524	10	739	9.89619	26	0.10381	700	47
14	887	9.79160	16	550	9.89514	10	786	9.89645	26	0.10355	693	46
15	61909	9.79176	16	78532	9.89504	9	78834	9.89671	26	0.10329	1.2685	45
16	932	9.79192	16	514	9.89495	10	881	9.89697	26	0.10303	677	44
17	955	9.79208	16	496	9.89485	10	928	9.89723	26	0.10277	670	43
18	978	9.79224	16	478	9.89475	10	975	9.89749	26	0.10251	662	42
19	62001	9.79240	16	460	9.89465	10	79022	9.89775	26	0.10225	655	41
20	62024	9.79256	16	78442	9.89455	10	79070	9.89801	26	0.10199	1.2647	40
21	046	9.79272	16	424	9.89445	10	117	9.89827	26	0.10173	640	39
22	069	9.79288	16	405	9.89435	10	164	9.89853	26	0.10147	632	38
23	092	9.79304	15	387	9.89425	10	212	9.89879	26	0.10121	624	37
24	115	9.79319	16	369	9.89415	10	259	9.89905	26	0.10095	617	36
25	62138	9.79335	16	78351	9.89405	10	79306	9.89931	26	0.10069	1.2609	35
26	160	9.79351	16	333	9.89395	10	354	9.89957	26	0.10043	602	34
27	183	9.79367	16	315	9.89385	10	401	9.89983	26	0.10017	594	33
28	206	9.79383	16	297	9.89375	11	449	9.90009	26	0.09991	587	32
29	229	9.79399	16	279	9.89364	10	496	9.90035	26	0.09965	579	31
30	62251	9.79415	16	78261	9.89354	10	79544	9.90061	25	0.09939	1.2572	30
31	274	9.79431	16	243	9.89344	10	591	9.90086	26	0.09914	564	29
32	297	9.79447	16	225	9.89334	10	639	9.90112	26	0.09888	557	28
33	320	9.79463	15	206	9.89324	10	686	9.90138	26	0.09862	549	27
34	342	9.79478	16	188	9.89314	10	734	9.90164	26	0.09836	542	26
35	62365	9.79494	16	78170	9.89304	10	79781	9.90190	26	0.09810	1.2534	25
36	388	9.79510	16	152	9.89294	10	829	9.90216	26	0.09784	527	24
37	411	9.79526	16	134	9.89284	10	877	9.90242	26	0.09758	519	23
38	433	9.79542	16	116	9.89274	10	924	9.90268	26	0.09732	512	22
39	456	9.79558	15	098	9.89264	10	972	9.90294	26	0.09706	504	21
40	62479	9.79573	16	78079	9.89254	10	80020	9.90320	26	0.09680	1.2497	20
41	502	9.79589	16	061	9.89244	11	067	9.90346	25	0.09654	489	19
42	524	9.79605	16	043	9.89233	10	115	9.90371	26	0.09629	482	18
43	547	9.79621	15	025	9.89223	10	163	9.90397	26	0.09603	475	17
44	570	9.79636	16	007	9.89213	10	211	9.90423	26	0.09577	467	16
45	62592	9.79652	16	77988	9.89203	10	80258	9.90449	26	0.09551	1.2460	15
46	615	9.79668	16	970	9.89193	10	306	9.90475	26	0.09525	452	14
47	638	9.79684	15	952	9.89183	10	354	9.90501	26	0.09499	445	13
48	660	9.79699	16	934	9.89173	11	402	9.90527	26	0.09473	437	12
49	683	9.79715	16	916	9.89162	10	450	9.90553	25	0.09447	430	11
50	62706	9.79731	15	77897	9.89152	10	80498	9.90578	26	0.09422	1.2423	10
51	728	9.79746	16	879	9.89142	10	546	9.90604	26	0.09396	415	9
52	751	9.79762	16	861	9.89132	10	594	9.90630	26	0.09370	408	8
53	774	9.79778	15	843	9.89122	10	642	9.90656	26	0.09344	401	7
54	796	9.79793	16	824	9.89112	11	690	9.90682	26	0.09318	393	6
55	62819	9.79809	16	77806	9.89101	10	80738	9.90708	26	0.09292	1.2386	5
56	842	9.79825	15	788	9.89091	10	786	9.90734	25	0.09266	378	4
57	864	9.79840	16	769	9.89081	10	834	9.90759	26	0.09241	371	3
58	887	9.79856	16	751	9.89071	11	882	9.90785	26	0.09215	364	2
59	909	9.79872	15	733	9.89060	10	930	9.90811	26	0.09189	356	1
60	932	9.79887		715	9.89050		978	9.90837		0.09163	349	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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′	Nat. **Sin**	Log.	d.	Nat. **Cos**	Log.	d.	Nat. **Tan**	Log.	c.d.	Log. **Cot**	Nat.	
0	62932	9.79887	16	77715	9.89050	10	80978	9.90837	26	0.09163	1.2349	60
1	955	9.79903	15	696	9.89040	10	81027	9.90863	26	0.09137	342	59
2	977	9.79918	16	678	9.89030	10	075	9.90889	25	0.09111	334	58
3	63000	9.79934	16	660	9.89020	11	123	9.90914	26	0.09086	327	57
4	022	9.79950	15	641	9.89009	10	171	9.90940	26	0.09060	320	56
5	63045	9.79965	16	77623	9.88999	10	81220	9.90966	26	0.09034	1.2312	55
6	068	9.79981	15	605	9.88989	11	268	9.90992	26	0.09008	305	54
7	090	9.79996	16	586	9.88978	10	316	9.91018	25	0.08982	298	53
8	113	9.80012	15	568	9.88968	10	364	9.91043	26	0.08957	290	52
9	135	9.80027	16	550	9.88958	10	413	9.91069	26	0.08931	283	51
10	63158	9.80043	15	77531	9.88948	11	81461	9.91095	26	0.08905	1.2276	50
11	180	9.80058	16	513	9.88937	10	510	9.91121	26	0.08879	268	49
12	203	9.80074	15	494	9.88927	10	558	9.91147	25	0.08853	261	48
13	225	9.80089	16	476	9.88917	11	606	9.91172	26	0.08828	254	47
14	248	9.80105	15	458	9.88906	10	655	9.91198	26	0.08802	247	46
15	63271	9.80120	16	77439	9.88896	10	81703	9.91224	26	0.08776	1.2239	45
16	293	9.80136	15	421	9.88886	11	752	9.91250	26	0.08750	232	44
17	316	9.80151	15	402	9.88875	10	800	9.91276	25	0.08724	225	43
18	338	9.80166	16	384	9.88865	10	849	9.91301	26	0.08699	218	42
19	361	9.80182	15	366	9.88855	11	898	9.91327	26	0.08673	210	41
20	63383	9.80197	16	77347	9.88844	10	81946	9.91353	26	0.08647	1.2203	40
21	406	9.80213	15	329	9.88834	10	995	9.91379	25	0.08621	196	39
22	428	9.80228	16	310	9.88824	11	82044	9.91404	26	0.08596	189	38
23	451	9.80244	15	292	9.88813	10	092	9.91430	26	0.08570	181	37
24	473	9.80259	15	273	9.88803	10	141	9.91456	26	0.08544	174	36
25	63496	9.80274	16	77255	9.88793	11	82190	9.91482	25	0.08518	1.2167	35
26	518	9.80290	15	236	9.88782	10	238	9.91507	26	0.08493	160	34
27	540	9.80305	15	218	9.88772	11	287	9.91533	26	0.08467	153	33
28	563	9.80320	16	199	9.88761	10	336	9.91559	26	0.08441	145	32
29	585	9.80336	15	181	9.88751	10	385	9.91585	25	0.08415	138	31
30	63608	9.80351	15	77162	9.88741	11	82434	9.91610	26	0.08390	1.2131	30
31	630	9.80366	16	144	9.88730	10	483	9.91636	26	0.08364	124	29
32	653	9.80382	15	125	9.88720	11	531	9.91662	26	0.08338	117	28
33	675	9.80397	15	107	9.88709	10	580	9.91688	25	0.08312	109	27
34	698	9.80412	16	088	9.88699	11	629	9.91713	26	0.08287	102	26
35	63720	9.80428	15	77070	9.88688	10	82678	9.91739	26	0.08261	1.2095	25
36	742	9.80443	15	051	9.88678	10	727	9.91765	26	0.08235	088	24
37	765	9.80458	15	033	9.88668	11	776	9.91791	25	0.08209	081	23
38	787	9.80473	16	014	9.88657	10	825	9.91816	26	0.08184	074	22
39	810	9.80489	15	76996	9.88647	11	874	9.91842	26	0.08158	066	21
40	63832	9.80504	15	76977	9.88636	10	82923	9.91868	25	0.08132	1.2059	20
41	854	9.80519	15	959	9.88626	11	972	9.91893	26	0.08107	052	19
42	877	9.80534	16	940	9.88615	10	83022	9.91919	26	0.08081	045	18
43	899	9.80550	15	921	9.88605	11	071	9.91945	26	0.08055	038	17
44	922	9.80565	15	903	9.88594	10	120	9.91971	25	0.08029	031	16
45	63944	9.80580	15	76884	9.88584	11	83169	9.91996	26	0.08004	1.2024	15
46	966	9.80595	15	866	9.88573	10	218	9.92022	26	0.07978	017	14
47	989	9.80610	15	847	9.88563	11	268	9.92048	25	0.07952	009	13
48	64011	9.80625	16	828	9.88552	10	317	9.92073	26	0.07927	002	12
49	033	9.80641	15	810	9.88542	10	366	9.92099	26	0.07901	1.1995	11
50	64056	9.80656	15	76791	9.88531	11	83415	9.92125	25	0.07875	1.1988	10
51	078	9.80671	15	772	9.88521	10	465	9.92150	26	0.07850	981	9
52	100	9.80686	15	754	9.88510	11	514	9.92176	26	0.07824	974	8
53	123	9.80701	15	735	9.88499	10	564	9.92202	25	0.07798	967	7
54	145	9.80716	15	717	9.88489	11	613	9.92227	26	0.07773	960	6
55	64167	9.80731	15	76698	9.88478	10	83662	9.92253	26	0.07747	1.1953	5
56	190	9.80746	16	679	9.88468	11	712	9.92279	25	0.07721	946	4
57	212	9.80762	15	661	9.88457	10	761	9.92304	26	0.07696	939	3
58	234	9.80777	15	642	9.88447	11	811	9.92330	26	0.07670	932	2
59	256	9.80792	15	623	9.88436	11	860	9.92356	25	0.07644	925	1
60	279	9.80807	15	604	9.88425	11	910	9.92381	26	0.07619	918	0
	Nat. **Cos**	Log.	d.	Nat. **Sin**	Log.	d.	Nat. **Cot**	Log.	c.d.	Log. **Tan**	Nat.	′

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40°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	64279	9.80807	15	76604	9.88425	10	83910	9.92381	26	0.07619	1.1918	60
1	301	9.80822	15	586	9.88415	11	960	9.92407	26	0.07593	910	59
2	323	9.80837	15	567	9.88404	10	84009	9.92433	25	0.07567	903	58
3	346	9.80852	15	548	9.88394	11	059	9.92458	26	0.07542	896	57
4	368	9.80867	15	530	9.88383	11	108	9.92484	26	0.07516	889	56
5	64390	9.80882	15	76511	9.88372	10	84158	9.92510	25	0.07490	1.1882	55
6	412	9.80897	15	492	9.88362	11	208	9.92535	26	0.07465	875	54
7	435	9.80912	15	473	9.88351	11	258	9.92561	26	0.07439	868	53
8	457	9.80927	15	455	9.88340	10	307	9.92587	25	0.07413	861	52
9	479	9.80942	15	436	9.88330	11	357	9.92612	26	0.07388	854	51
10	64501	9.80957	15	76417	9.88319	11	84407	9.92638	25	0.07362	1.1847	50
11	524	9.80972	15	398	9.88308	10	457	9.92663	26	0.07337	840	49
12	546	9.80987	15	380	9.88298	11	507	9.92689	26	0.07311	833	48
13	568	9.81002	15	361	9.88287	11	556	9.92715	25	0.07285	826	47
14	590	9.81017	15	342	9.88276	10	606	9.92740	26	0.07260	819	46
15	64612	9.81032	15	76323	9.88266	11	84656	9.92766	26	0.07234	1.1812	45
16	635	9.81047	14	304	9.88255	11	706	9.92792	25	0.07208	806	44
17	657	9.81061	15	286	9.88244	10	756	9.92817	26	0.07183	799	43
18	679	9.81076	15	267	9.88234	11	806	9.92843	25	0.07157	792	42
19	701	9.81091	15	248	9.88223	11	856	9.92868	26	0.07132	785	41
20	64723	9.81106	15	76229	9.88212	11	84906	9.92894	26	0.07106	1.1778	40
21	746	9.81121	15	210	9.88201	10	956	9.92920	25	0.07080	771	39
22	768	9.81136	15	192	9.88191	11	85006	9.92945	26	0.07055	764	38
23	790	9.81151	15	173	9.88180	11	057	9.92971	25	0.07029	757	37
24	812	9.81166	14	154	9.88169	11	107	9.92996	26	0.07004	750	36
25	64834	9.81180	15	76135	9.88158	10	85157	9.93022	26	0.06978	1.1743	35
26	856	9.81195	15	116	9.88148	11	207	9.93048	25	0.06952	736	34
27	878	9.81210	15	097	9.88137	11	257	9.93073	26	0.06927	729	33
28	901	9.81225	15	078	9.88126	11	308	9.93099	25	0.06901	722	32
29	923	9.81240	15	059	9.88115	11	358	9.93124	26	0.06876	715	31
30	64945	9.81254	14	76041	9.88105	10	85408	9.93150	25	0.06850	1.1708	30
31	967	9.81269	15	022	9.88094	11	458	9.93175	26	0.06825	702	29
32	989	9.81284	15	003	9.88083	11	509	9.93201	26	0.06799	695	28
33	65011	9.81299	15	75984	9.88072	11	559	9.93227	25	0.06773	688	27
34	033	9.81314	14	965	9.88061	10	609	9.93252	26	0.06748	681	26
35	65055	9.81328	15	75946	9.88051	11	85660	9.93278	25	0.06722	1.1674	25
36	077	9.81343	15	927	9.88040	11	710	9.93303	26	0.06697	667	24
37	100	9.81358	14	908	9.88029	11	761	9.93329	25	0.06671	660	23
38	122	9.81372	15	889	9.88018	11	811	9.93354	26	0.06646	653	22
39	144	9.81387	15	870	9.88007	11	862	9.93380	26	0.06620	647	21
40	65166	9.81402	15	75851	9.87996	11	85912	9.93406	25	0.06594	1.1640	20
41	188	9.81417	14	832	9.87985	10	963	9.93431	26	0.06569	633	19
42	210	9.81431	15	813	9.87975	11	86014	9.93457	25	0.06543	626	18
43	232	9.81446	15	794	9.87964	11	064	9.93482	26	0.06518	619	17
44	254	9.81461	14	775	9.87953	11	115	9.93508	25	0.06492	612	16
45	65276	9.81475	15	75756	9.87942	11	86166	9.93533	26	0.06467	1.1606	15
46	298	9.81490	15	738	9.87931	11	216	9.93559	25	0.06441	599	14
47	320	9.81505	14	719	9.87920	11	267	9.93584	26	0.06416	592	13
48	342	9.81519	15	700	9.87909	11	318	9.93610	26	0.06390	585	12
49	364	9.81534	15	680	9.87898	11	368	9.93636	25	0.06364	578	11
50	65386	9.81549	14	75661	9.87887	10	86419	9.93661	26	0.06339	1.1571	10
51	408	9.81563	15	642	9.87877	11	470	9.93687	25	0.06313	565	9
52	430	9.81578	14	623	9.87866	11	521	9.93712	26	0.06288	558	8
53	452	9.81592	15	604	9.87855	11	572	9.93738	25	0.06262	551	7
54	474	9.81607	15	585	9.87844	11	623	9.93763	26	0.06237	544	6
55	65496	9.81622	14	75566	9.87833	11	86674	9.93789	25	0.06211	1.1538	5
56	518	9.81636	15	547	9.87822	11	725	9.93814	26	0.06186	531	4
57	540	9.81651	14	528	9.87811	11	776	9.93840	25	0.06160	524	3
58	562	9.81665	15	509	9.87800	11	827	9.93865	26	0.06135	517	2
59	584	9.81680	15	490	9.87789	11	878	9.93891	25	0.06109	510	1
60	606	9.81694	14	471	9.87778	11	929	9.93916	25	0.06084	504	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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41°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	65606	9.81694	15	75471	9.87778	11	86929	9.93916	26	0.06084	1.1504	60
1	628	9.81709	14	452	9.87767	11	980	9.93942	25	0.06058	497	59
2	650	9.81723	15	433	9.87756	11	87031	9.93967	26	0.06033	490	58
3	672	9.81738	14	414	9.87745	11	082	9.93993	25	0.06007	483	57
4	694	9.81752	15	395	9.87734	11	133	9.94018	26	0.05982	477	56
5	65716	9.81767	14	75375	9.87723	11	87184	9.94044	25	0.05956	1.1470	55
6	738	9.81781	15	356	9.87712	11	236	9.94069	26	0.05931	463	54
7	759	9.81796	14	337	9.87701	11	287	9.94095	25	0.05905	456	53
8	781	9.81810	15	318	9.87690	11	338	9.94120	26	0.05880	450	52
9	803	9.81825	14	299	9.87679	11	389	9.94146	25	0.05854	443	51
10	65825	9.81839	15	75280	9.87668	11	87441	9.94171	26	0.05829	1.1436	50
11	847	9.81854	14	261	9.87657	11	492	9.94197	25	0.05803	430	49
12	869	9.81868	14	241	9.87646	11	543	9.94222	26	0.05778	423	48
13	891	9.81882	15	222	9.87635	11	595	9.94248	25	0.05752	416	47
14	913	9.81897	14	203	9.87624	11	646	9.94273	26	0.05727	410	46
15	65935	9.81911	15	75184	9.87613	12	87698	9.94299	25	0.05701	1.1403	45
16	956	9.81926	14	165	9.87601	11	749	9.94324	26	0.05676	396	44
17	978	9.81940	15	146	9.87590	11	801	9.94350	25	0.05650	389	43
18	66000	9.81955	14	126	9.87579	11	852	9.94375	26	0.05625	383	42
19	022	9.81969	14	107	9.87568	11	904	9.94401	25	0.05599	376	41
20	66044	9.81983	15	75088	9.87557	11	87955	9.94426	26	0.05574	1.1369	40
21	066	9.81998	14	069	9.87546	11	88007	9.94452	25	0.05548	363	39
22	088	9.82012	14	050	9.87535	11	059	9.94477	26	0.05523	356	38
23	109	9.82026	15	030	9.87524	11	110	9.94503	25	0.05497	349	37
24	131	9.82041	14	011	9.87513	12	162	9.94528	26	0.05472	343	36
25	66153	9.82055	14	74992	9.87501	11	88214	9.94554	25	0.05446	1.1336	35
26	175	9.82069	15	973	9.87490	11	265	9.94579	25	0.05421	329	34
27	197	9.82084	14	953	9.87479	11	317	9.94604	26	0.05396	323	33
28	218	9.82098	14	934	9.87468	11	369	9.94630	25	0.05370	316	32
29	240	9.82112	14	915	9.87457	11	421	9.94655	26	0.05345	310	31
30	66262	9.82126	15	74896	9.87446	12	88473	9.94681	25	0.05319	1.1303	30
31	284	9.82141	14	876	9.87434	11	524	9.94706	26	0.05294	296	29
32	306	9.82155	14	857	9.87423	11	576	9.94732	25	0.05268	290	28
33	327	9.82169	15	838	9.87412	11	628	9.94757	26	0.05243	283	27
34	349	9.82184	14	818	9.87401	11	680	9.94783	25	0.05217	276	26
35	66371	9.82198	14	74799	9.87390	12	88732	9.94808	26	0.05192	1.1270	25
36	393	9.82212	14	780	9.87378	11	784	9.94834	25	0.05166	263	24
37	414	9.82226	14	760	9.87367	11	836	9.94859	25	0.05141	257	23
38	436	9.82240	15	741	9.87356	11	888	9.94884	26	0.05116	250	22
39	458	9.82255	14	722	9.87345	11	940	9.94910	25	0.05090	243	21
40	66480	9.82269	14	74703	9.87334	12	88992	9.94935	26	0.05065	1.1237	20
41	501	9.82283	14	683	9.87322	11	89045	9.94961	25	0.05039	230	19
42	523	9.82297	14	664	9.87311	11	097	9.94986	26	0.05014	224	18
43	545	9.82311	15	644	9.87300	12	149	9.95012	25	0.04988	217	17
44	566	9.82326	14	625	9.87288	11	201	9.95037	25	0.04963	211	16
45	66588	9.82340	14	74606	9.87277	11	89253	9.95062	26	0.04938	1.1204	15
46	610	9.82354	14	586	9.87266	11	306	9.95088	25	0.04912	197	14
47	632	9.82368	14	567	9.87255	12	358	9.95113	26	0.04887	191	13
48	653	9.82382	14	548	9.87243	11	410	9.95139	25	0.04861	184	12
19	675	9.82396	14	528	9.87232	11	463	9.95164	26	0.04836	178	11
50	66697	9.82410	14	74509	9.87221	12	89515	9.95190	25	0.04810	1.1171	10
51	718	9.82424	15	489	9.87209	11	567	9.95215	25	0.04785	165	9
52	740	9.82439	14	470	9.87198	11	620	9.95240	26	0.04760	158	8
53	762	9.82453	14	451	9.87187	12	672	9.95266	25	0.04734	152	7
54	783	9.82467	14	431	9.87175	11	725	9.95291	26	0.04709	145	6
55	66805	9.82481	14	74412	9.87164	11	89777	9.95317	25	0.04683	1.1139	5
56	827	9.82495	14	392	9.87153	12	830	9.95342	26	0.04658	132	4
57	848	9.82509	14	373	9.87141	11	883	9.95368	25	0.04632	126	3
58	870	9.82523	14	353	9.87130	11	935	9.95393	25	0.04607	119	2
59	891	9.82537	14	334	9.87119	12	988	9.95418	26	0.04582	113	1
60	913	9.82551		314	9.87107		90040	9.95444		0.04556	106	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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42°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	′
0	66913	9.82551	14	74314	9.87107	11	90040	9.95444	25	0.04556	1.1106	60
1	935	9.82565	14	295	9.87096	11	093	9.95469	26	0.04531	100	59
2	956	9.82579	14	276	9.87085	12	146	9.95495	25	0.04505	093	58
3	978	9.82593	14	256	9.87073	11	199	9.95520	25	0.04480	087	57
4	999	9.82607	14	237	9.87062	12	251	9.95545	26	0.04455	080	56
5	67021	9.82621	14	74217	9.87050	11	90304	9.95571	25	0.04429	1.1074	55
6	043	9.82635	14	198	9.87039	11	357	9.95596	26	0.04404	067	54
7	064	9.82649	14	178	9.87028	12	410	9.95622	25	0.04378	061	53
8	086	9.82663	14	159	9.87016	11	463	9.95647	25	0.04353	054	52
9	107	9.82677	14	139	9.87005	12	516	9.95672	26	0.04328	048	51
10	67129	9.82691	14	74120	9.86993	11	90569	9.95698	25	0.04302	1.1041	50
11	151	9.82705	14	100	9.86982	12	621	9.95723	25	0.04277	035	49
12	172	9.82719	14	080	9.86970	11	674	9.95748	26	0.04252	028	48
13	194	9.82733	14	061	9.86959	12	727	9.95774	25	0.04226	022	47
14	215	9.82747	14	041	9.86947	11	781	9.95799	26	0.04201	016	46
15	67237	9.82761	14	74022	9.86936	12	90834	9.95825	25	0.04175	1.1009	45
16	258	9.82775	13	002	9.86924	11	887	9.95850	25	0.04150	003	44
17	280	9.82788	14	73983	9.86913	11	940	9.95875	26	0.04125	1.0996	43
18	301	9.82802	14	963	9.86902	12	993	9.95901	25	0.04099	990	42
19	323	9.82816	14	944	9.86890	11	91046	9.95926	26	0.04074	983	41
20	67344	9.82830	14	73924	9.86879	12	91099	9.95952	25	0.04048	1.0977	40
21	366	9.82844	14	904	9.86867	12	153	9.95977	25	0.04023	971	39
22	387	9.82858	14	885	9.86855	11	206	9.96002	26	0.03998	964	38
23	409	9.82872	13	865	9.86844	12	259	9.96028	25	0.03972	958	37
24	430	9.82885	14	846	9.86832	12	313	9.96053	25	0.03947	951	36
25	67452	9.82899	14	73826	9.86821	11	91366	9.96078	26	0.03922	1.0945	35
26	473	9.82913	14	806	9.86809	12	419	9.96104	25	0.03896	939	34
27	495	9.82927	14	787	9.86798	11	473	9.96129	26	0.03871	932	33
28	516	9.82941	14	767	9.86786	12	526	9.96155	25	0.03845	926	32
29	538	9.82955	13	747	9.86775	11	580	9.96180	25	0.03820	919	31
30	67559	9.82968	14	73728	9.86763	12	91633	9.96205	26	0.03795	1.0913	30
31	580	9.82982	14	708	9.86752	11	687	9.96231	25	0.03769	907	29
32	602	9.82996	14	688	9.86740	12	740	9.96256	25	0.03744	900	28
33	623	9.83010	13	669	9.86728	12	794	9.96281	26	0.03719	894	27
34	645	9.83023	14	649	9.86717	11	847	9.96307	25	0.03693	888	26
35	67666	9.83037	14	73629	9.86705	12	91901	9.96332	25	0.03668	1.0881	25
36	688	9.83051	14	610	9.86694	11	955	9.96357	26	0.03643	875	24
37	709	9.83065	13	590	9.86682	12	92008	9.96383	25	0.03617	869	23
38	730	9.83078	14	570	9.86670	12	062	9.96408	25	0.03592	862	22
39	752	9.83092	14	551	9.86659	11	116	9.96433	26	0.03567	856	21
40	67773	9.83106	14	73531	9.86647	12	92170	9.96459	25	0.03541	1.0850	20
41	795	9.83120	13	511	9.86635	11	224	9.96484	26	0.03516	843	19
42	816	9.83133	14	491	9.86624	12	277	9.96510	25	0.03490	837	18
43	837	9.83147	14	472	9.86612	12	331	9.96535	25	0.03465	831	17
44	859	9.83161	13	452	9.86600	11	385	9.96560	26	0.03440	824	16
45	67880	9.83174	14	73432	9.86589	12	92439	9.96586	25	0.03414	1.0818	15
46	901	9.83188	14	413	9.86577	12	493	9.96611	25	0.03389	812	14
47	923	9.83202	13	393	9.86565	11	547	9.96636	26	0.03364	805	13
48	944	9.83215	14	373	9.86554	12	601	9.96662	25	0.03338	799	12
49	965	9.83229	13	353	9.86542	12	655	9.96687	25	0.03313	793	11
50	67987	9.83242	14	73333	9.86530	12	92709	9.96712	26	0.03288	1.0786	10
51	68008	9.83256	14	314	9.86518	11	763	9.96738	25	0.03262	780	9
52	029	9.83270	13	294	9.86507	12	817	9.96763	25	0.03237	774	8
53	051	9.83283	14	274	9.86495	12	872	9.96788	26	0.03212	768	7
54	072	9.83297	13	254	9.86483	11	926	9.96814	25	0.03186	761	6
55	68093	9.83310	14	73234	9.86472	12	92980	9.96839	25	0.03161	1.0755	5
56	115	9.83324	14	215	9.86460	12	93034	9.96864	26	0.03136	749	4
57	136	9.83338	13	195	9.86448	12	088	9.96890	25	0.03110	742	3
58	157	9.83351	14	175	9.86436	11	143	9.96915	25	0.03085	736	2
59	179	9.83365	13	155	9.86425	12	197	9.96940	26	0.03060	730	1
60	200	9.83378	13	135	9.86413	12	252	9.96966	26	0.03034	724	0
	Nat. Cos	Log.	d.	Nat. Sin	Log.	d.	Nat. Cot	Log.	c.d.	Log. Tan	Nat.	′

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43°

′	Nat. **Sin**	Log.	d.	Nat. **Cos**	Log.	d.	Nat. **Tan**	Log.	c.d.	Log. **Cot**	Nat.	
0	68200	9.83378	14	73135	9.86413	12	93252	9.96966	25	0.03034	1.0724	60
1	221	9.83392	13	116	9.86401	12	306	9.96991	25	0.03009	717	59
2	242	9.83405	14	096	9.86389	12	360	9.97016	26	0.02984	711	58
3	264	9.83419	13	076	9.86377	11	415	9.97042	25	0.02958	705	57
4	285	9.83432	14	056	9.86366	12	469	9.97067	25	0.02933	699	56
5	68306	9.83446	13	73036	9.86354	12	93524	9.97092	26	0.02908	1.0692	55
6	327	9.83459	14	016	9.86342	12	578	9.97118	25	0.02882	686	54
7	349	9.83473	13	72996	9.86330	12	633	9.97143	25	0.02857	680	53
8	370	9.83486	14	976	9.86318	12	688	9.97168	25	0.02832	674	52
9	391	9.83500	13	957	9.86306	11	742	9.97193	26	0.02807	668	51
10	68412	9.83513	14	72937	9.86295	12	93797	9.97219	25	0.02781	1.0661	50
11	434	9.83527	13	917	9.86283	12	852	9.97244	25	0.02756	655	49
12	455	9.83540	14	897	9.86271	12	906	9.97269	26	0.02731	649	48
13	476	9.83554	13	877	9.86259	12	961	9.97295	25	0.02705	643	47
14	497	9.83567	14	857	9.86247	12	94016	9.97320	25	0.02680	637	46
15	68518	9.83581	13	72837	9.86235	12	94071	9.97345	26	0.02655	1.0630	45
16	539	9.83594	14	817	9.86223	12	125	9.97371	25	0.02629	624	44
17	561	9.83608	13	797	9.86211	11	180	9.97396	25	0.02604	618	43
18	582	9.83621	13	777	9.86200	12	235	9.97421	26	0.02579	612	42
19	603	9.83634	14	757	9.86188	12	290	9.97447	25	0.02553	606	41
20	68624	9.83648	13	72737	9.86176	12	94345	9.97472	25	0.02528	1.0599	40
21	645	9.83661	13	717	9.86164	12	400	9.97497	26	0.02503	593	39
22	666	9.83674	13	697	9.86152	12	455	9.97523	25	0.02477	587	38
23	688	9.83688	14	677	9.86140	12	510	9.97548	25	0.02452	581	37
24	709	9.83701	13	657	9.86128	12	565	9.97573	25	0.02427	575	36
25	68730	9.83715	13	72637	9.86116	12	94620	9.97598	26	0.02402	1.0569	35
26	751	9.83728	13	617	9.86104	12	676	9.97624	25	0.02376	562	34
27	772	9.83741	14	597	9.86092	12	731	9.97649	25	0.02351	556	33
28	793	9.83755	13	577	9.86080	12	786	9.97674	26	0.02326	550	32
29	814	9.83768	13	557	9.86068	12	841	9.97700	25	0.02300	544	31
30	68835	9.83781	14	72537	9.86056	12	94896	9.97725	25	0.02275	1.0538	30
31	857	9.83795	13	517	9.86044	12	952	9.97750	26	0.02250	532	29
32	878	9.83808	13	497	9.86032	12	95007	9.97776	25	0.02224	526	28
33	899	9.83821	13	477	9.86020	12	062	9.97801	25	0.02199	519	27
34	920	9.83834	14	457	9.86008	12	118	9.97826	25	0.02174	513	26
35	68941	9.83848	13	72437	9.85996	12	95173	9.97851	26	0.02149	1.0507	25
36	962	9.83861	13	417	9.85984	12	229	9.97877	25	0.02123	501	24
37	983	9.83874	13	397	9.85972	12	284	9.97902	25	0.02098	495	23
38	69004	9.83887	14	377	9.85960	12	340	9.97927	26	0.02073	489	22
39	025	9.83901	13	357	9.85948	12	395	9.97953	25	0.02047	483	21
40	69046	9.83914	13	72337	9.85936	12	95451	9.97978	25	0.02022	1.0477	20
41	067	9.83927	13	317	9.85924	12	506	9.98003	26	0.01997	470	19
42	088	9.83940	14	297	9.85912	12	562	9.98029	25	0.01971	464	18
43	109	9.83954	13	277	9.85900	12	618	9.98054	25	0.01946	458	17
44	130	9.83967	13	257	9.85888	12	673	9.98079	25	0.01921	452	16
45	69151	9.83980	13	72236	9.85876	12	95729	9.98104	26	0.01896	1.0446	15
46	172	9.83993	13	216	9.85864	13	785	9.98130	25	0.01870	440	14
47	193	9.84006	14	196	9.85851	12	841	9.98155	25	0.01845	434	13
48	214	9.84020	13	176	9.85839	12	897	9.98180	26	0.01820	428	12
49	235	9.84033	13	156	9.85827	12	952	9.98206	25	0.01794	422	11
50	69256	9.84046	13	72136	9.85815	12	96008	9.98231	25	0.01769	1.0416	10
51	277	9.84059	13	116	9.85803	12	064	9.98256	25	0.01744	410	9
52	298	9.84072	13	095	9.85791	12	120	9.98281	26	0.01719	404	8
53	319	9.84085	13	075	9.85779	13	176	9.98307	25	0.01693	398	7
54	340	9.84098	14	055	9.85766	12	232	9.98332	25	0.01668	392	6
55	69361	9.84112	13	72035	9.85754	12	96288	9.98357	26	0.01643	1.0385	5
56	382	9.84125	13	015	9.85742	12	344	9.98383	25	0.01617	379	4
57	403	9.84138	13	71995	9.85730	12	400	9.98408	25	0.01592	373	3
58	424	9.84151	13	974	9.85718	12	457	9.98433	25	0.01567	367	2
59	445	9.84164	13	954	9.85706	12	513	9.98458	25	0.01542	361	1
60	466	9.84177	13	934	9.85693	13	569	9.98484	26	0.01516	355	0
	Nat. **Cos**	Log.	d.	Nat. **Sin**	Log.	d.	Nat. **Cot**	Log.	c.d.	Log. **Tan**	Nat.	′

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44°

′	Nat. Sin	Log.	d.	Nat. Cos	Log.	d.	Nat. Tan	Log.	c.d.	Log. Cot	Nat.	
0	69466	9.84177	13	71934	9.85693	12	96569	9.98484	25	0.01516	1.0355	60
1	487	9.84190	13	914	9.85681	12	625	9.98509	25	0.01491	349	59
2	508	9.84203	13	894	9.85669	12	681	9.98534	26	0.01466	343	58
3	529	9.84216	13	873	9.85657	12	738	9.98560	25	0.01440	337	57
4	549	9.84229	13	853	9.85645	13	794	9.98585	25	0.01415	331	56
5	69570	9.84242	13	71833	9.85632	12	96850	9.98610	25	0.01390	1.0325	55
6	591	9.84255	13	813	9.85620	12	907	9.98635	26	0.01365	319	54
7	612	9.84269	14	792	9.85608	12	963	9.98661	25	0.01339	313	53
8	633	9.84282	13	772	9.85596	13	97020	9.98686	25	0.01314	307	52
9	654	9.84295	13	752	9.85583	12	076	9.98711	26	0.01289	301	51
10	69675	9.84308	13	71732	9.85571	12	97133	9.98737	25	0.01263	1.0295	50
11	696	9.84321	13	711	9.85559	12	189	9.98762	25	0.01238	289	49
12	717	9.84334	13	691	9.85547	13	246	9.98787	25	0.01213	283	48
13	737	9.84347	13	671	9.85534	12	302	9.98812	26	0.01188	277	47
14	758	9.84360	13	650	9.85522	12	359	9.98832	25	0.01162	271	46
15	69779	9.84373	12	71630	9.85510	13	97416	9.98863	25	0.01137	1.0265	45
16	800	9.84385	13	610	9.85497	12	472	9.98888	25	0.01112	259	44
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22	925	9.84463	13	488	9.85423	12	813	9.99040	25	0.00960	224	38
23	946	9.84476	13	468	9.85411	12	870	9.99065	25	0.00935	218	37
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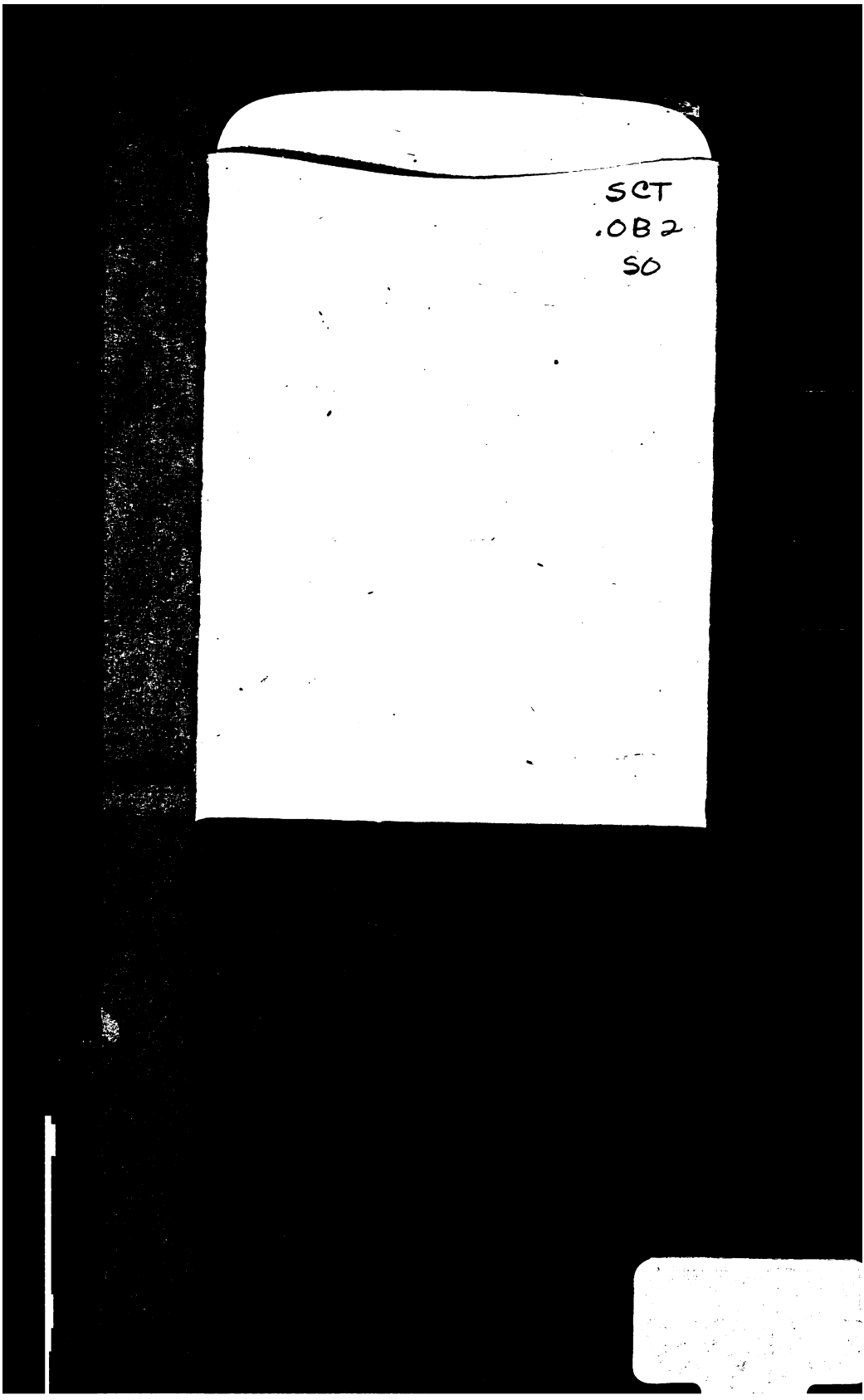
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